Project Manual
For Construction

UNIVERSITY OF COLORADO
THEATER ADA ADDITION
Boulder, Colorado 80309

28 August 2009

 semplesbrowndesign
architecture | interiors | vision

Project No.: 080320
# PROJECT DIRECTORY

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Boulder, Colorado  80309  
PROJECT NO:  080320

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August 2009  
University of Colorado Theater ADA Addition  
Boulder, Colorado  
SBDesign Project No. 080320

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Sections include the following:

1. Division 01 Section "Summary" for use of premises, and Owner-occupancy requirements.
2. Division 01 Section "Photographic Documentation" for preconstruction photographs taken before selective demolition operations.
3. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
4. Division 01 Section "Cutting and Patching" for cutting and patching procedures.
5. Division 01 Section "Construction Waste Management and Disposal" for disposal of demolished materials.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 SUBMITTALS

A. Qualification Data: For demolition firm, refrigerant recovery technician.

B. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's building manager's and other tenants' on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutdown, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Locations of proposed dust- and noise-control temporary partitions and means of egress, including for other tenants affected by selective demolition operations.
6. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
7. Means of protection for items to remain and items in path of waste removal from building.

C. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

D. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 Section "Photographic Documentation." Submit before Work begins.

E. Landfill Records: Indicate receipt and acceptance of Hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1. Comply with submittal requirements in Division 01 Section "Construction Waste Management and Disposal."

1.5 QUALITY ASSURANCE

A. Demolition Firm Qualifications: An experienced firm that has specialized in demolition work similar in material and extent to that indicated for this Project.

B. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

C. LEED Requirements for Building Reuse:

1. Credit MR 1.1 and 1.2: Maintain existing building structure (including structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and nonstructural roofing material) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
2. Credit MR 1.3: Maintain existing interior nonstructural elements (interior walls, doors, floor coverings, and ceiling systems) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.
3. Credit MR 1.2 and 1.3: Maintain existing nonshell, nonstructural components (walls, flooring, and ceilings) not indicated to be demolished; do not demolish such existing construction beyond indicated limits.

D. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

E. Standards: Comply with ANSI A10.6 and NFPA 241.

F. Predemolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1.6 PROJECT CONDITIONS

A. Owner will occupy building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
   1. Comply with requirements specified in Division 01 Section "Summary."

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
   1. Furniture.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
   1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.

D. Hazardous Materials: It is unknown whether hazardous materials will be encountered in the Work.
   1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
      a. Paint on existing masonry.

E. Storage or sale of removed items or materials on-site is not permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
   1. Maintain fire-protection facilities in service during selective demolition operations.

1.7 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs.
   1. Comply with requirements specified in Division 01 Section "Photographic Documentation."

G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
   1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
   2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
   1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
   2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
   3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
   4. Cover and protect furniture, furnishings, and equipment that have not been removed.
5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Dispose of demolished items and materials promptly.

B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements as follows. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.

1. Building Structure and Shell: 100 percent.
2. Nonshell Elements: 50 percent.

C. Removed and Reinstalled Items: Shown on Drawings.

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch (19 mm) at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
   1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

E. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
   3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119
SECTION 033000 - CAST-IN-PLACE CONCRETE

PART I - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Foundation walls.
3. Slabs-on-grade.
4. Suspended slabs.
5. Concrete toppings.

B. Related Sections include the following:

1. Division 03 Section "Architectural Concrete" for general building applications of specially finished formed concrete.
2. Division 31 Section "Earth Moving" for drainage fill under slabs-on-grade.
3. Division 32 Section "Concrete Paving" for concrete pavement and walks.
4. Division 32 Section "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.
2. Submit substantiating data for each concrete mix design contemplated for use to the Architect/Engineer not less than four weeks prior to first concrete placement. Data for each mix shall, as a minimum, include the following:

   a. Mix identification designation (unique for each mix submitted).
   b. Statement of intended use for mix.
   c. Mixture proportions and descriptions.
d. Wet and dry unit weight.
c. Water/cementitious materials ratio.
f. Total air content.
g. Design slump.
h. Intended method of placement in field.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1. Show all reinforcing, top and bottom profile of concrete element, supports below, and concrete walls, grade beams, joists, etc. framing into the element.
2. Provide one continuous elevation at 1/4" scale for all beams, joists, or walls in a common line. Show pockets and openings in shear walls, structural slabs, beams, elevation at top of beams, walls, columns, sections through all beams, pilasters and columns, and placing sequence of reinforcing for items with more than one reinforcing layer.
3. Show locations of approved construction joints, splices of reinforcing, type of splice used and splice location, grade of all reinforcement used and specifically identify all ASTM A706 and epoxy coated reinforcing.

D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Alkali-Aggregate Reactivity of Aggregates. Submit test reports indicating that fine and coarse aggregates are not “potentially reactive” based on the ASTM C295 or ASTM C1260 (or ASTM C1293) testing limits set forth in Section 5.1 of “Guide Specification for Concrete Subject to Alkali-Silica Reactions” (2007 Portland Cement Association). Alternately, submit ASTM C1567 test reports indicating that the combination of mix ingredients reduces the expansion due to alkali aggregate reactivity such that the mix complies with Section 5.2 of “Guide Specification for Concrete Subject to Alkali-Silica Reactions” (2007 Portland Cement Association). All tests for submitted reports shall have been performed within one year of the submittal date.

E. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Curing compounds.
8. Vapor retarders.

F. Minutes of preinstallation conference.

G. Placement notification: Advance notification of concrete placement, submit notification at least 24 hours in advance.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade I, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be 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.
3. Concrete reinforcing steel shall be inspected by personnel experienced in concrete construction and acceptable to the Architect/Engineer. Personnel currently certified as an ACI Concrete Construction Inspector will be accepted.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

E. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

F. Formwork: Design and engineering of formwork shall be the responsibility of the Contractor. Design of formwork and preparation of formwork drawings shall be under the supervision of a professional engineer registered in the state of project.

G. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:


H. Mockups: Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.

1. Build panel approximately 200 sq. ft. (18.6 sq. m) for slab-on-grade and 100 sq. ft. (9.3 sq. m) for formed surface in the location indicated or, if not indicated, as directed by Architect.
2. Approved panels may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. 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. Owner's testing/inspection agency.
2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

3. Minutes of the meeting shall be recorded, typed, and printed by the Contractor and distributed by him to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes: Owner’s Representative – Consultant Engineer.

The minutes shall include a statement by the concrete contractor indicating that the proposed mix design, and placing, finishing and curing procedures can produce the concrete quality required by these specifications.

J. Record of Work: Maintain a record listing the time and date of placement of all concrete for the structure. Retain batch tickets for all concrete. Such record shall be kept until the completion of the project and shall be available to the Architect for examination at any time.

K. Pre-placement Inspection: Formwork installation, reinforcing steel placement, and installation of all items to be embedded or cast into concrete shall be verified by the Contractor prior to placement.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

   a. High-density overlay, Class 1 or better.
   b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
   c. Structural 1, B-B or better; mill oiled and edge sealed.
   d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or 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. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

G. 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.

H. 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 corrodbile metal closer than 1-1/2 inch to the plane of exposed concrete surface.
   2. Furnish ties that, when removed, will leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
   3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Low-Alloy-Steel Reinforcing Bars: where welding of reinforcement or field bending is noted on the drawings ASTM A 706/A 706M, deformed.

C. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M for bars that may be field bent or ASTM A 934/A 934M epoxy coated.

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

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), plain-steel bars, ASTM A 775/A 775M epoxy coated.
C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project. Alternate cementitious materials, when proposed to control alkali-silica reactions and tested as part of a representative complete concrete mix in accordance with ASTM C1567, may be used subject to approval:

1. Portland Cement: ASTM C 150, Type I/II gray unless otherwise noted. Supplement with the following:
   a. Fly Ash: ASTM C 618, Class C or F.

B. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate or better, graded. All coarse and fine aggregates shall be tested per ASTM C295 or ASTM C1260 (or ASTM C 1293) in accordance with Section 5.1 of "Guide Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association). Provide aggregates from a single source.


2.6 ADMIXTURES


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 C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
7. Non-Chloride, Non-Corrosive Accelerating Admixture: The admixture shall conform to ASTM C494, Type C or E, and not contain more chloride ions than are present in municipal drinking water. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year’s duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures.
8. Mid-range water reducing admixture shall be EUCON X15 or EUCON MR by The Euclid Chemical Company, DARACEM or Mira Series by W. R. Grace or POZZOLITH997 or Rheobuild 3000 by Master Builders and shall conform to ASTM C494 Type A.

C. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products:
   a. Axim Concrete Technologies; Catexol 1000C1.
   c. Grace Construction Products, W. R. Grace & Co.; DC1-S.
   d. Master Builders, Inc.; Rheocrete 222+. 
   e. Sika Corporation; FerroGard-901.

2.7 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long.

B. Macro-synthetic Fiber: Polypropylene and or polyethylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III

2.8 FLOOR AND SLAB TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; colorless; that penetrates, hardens, and densifies concrete surfaces.

1. Vehicular Surfaces: Material suitable for application on horizontal surfaces subjected to vehicular traffic shall contain not less than 40 percent silane. Provide certification of 95 percent chloride screen effectiveness when tested in accordance with the procedure of NCHRP Report No. 244 “Southern Climate Exposure”, at Manufacturer’s recommended rate of application. Also provide certification that product meets Alberta Transportation and Utilities BT-003 at 45 percent Relative Moisture results of greater than 85 percent both initial and post abrasion performance. Application rate shall be 125 square feet per gallon.

2. Non-Vehicular Surfaces: Material suitable for application on horizontal surfaces not subjected to vehicular traffic shall be not less than 40 percent silane, or 9 percent poly-siloxane, or shall be 20 percent siloxane. Provide certification of 90-percent chloride screen effectiveness when tested in accordance with the procure in NCHRP Report No. 244, “Southern Climate Exposure” at Manufacturer’s recommended rate of application.

2.9 CURING MATERIALS

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

1. Available Products:
   a. Axim Concrete Technologies; Cimfilm.
   b. Burke by Edoco; BurkeFilm.
c. ChemMasters; Spray-Film.
d. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
e. Dayton Superior Corporation; Sure Film.
f. Euclid Chemical Company (The); Eucobar.
g. Kaufman Products, Inc.; Vapor Aid.
h. Lambert Corporation; Lambeo Skin.
i. L&M Construction Chemicals, Inc.; E-Con.
j. MBT Protection and Repair, Div. of ChemRex; Confilm.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
n. Sika Corporation, Inc.; SikaFilm.
o. Symons Corporation, a Dayton Superior Company; Finishing Aid.
p. Unitex; Pro-Film.
q. US Mix Products Company; US Spec Monofilm ER.
r. Vextex Chemicals, Inc.; Certi-Vex EnvioAssist.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type I, Class A. Have test data from an Independent Laboratory indicating a maximum moisture loss of 0.30 kg/m² at 72 hours when tested in accordance with ASTM C156.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type I, Class A. Have test data from an Independent Laboratory indicating a maximum moisture loss of 0.30 kg/m² at 72 hours when tested in accordance with ASTM C156.

2.10 RELATED MATERIALS


B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.11 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3.2 mm) and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch (3.2 to 6 mm) or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi (34.5 MPa) at 28 days when tested according to ASTM C 109/C 109M.

2.12 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: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows

1. Fly Ash: 25 percent

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 for reinforced concrete exposed to chlorides in service, 0.30 for other reinforced concrete, 1.00 for reinforced concrete that will be dry and protected from moisture in service percent by weight of cement.

D. 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, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.13 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Proportion structural normal weight concrete mixture as noted on the drawings, unless aggregates are “potentially reactive” with alkalis based on the ASTM C295 or ASTM C1260 (or ASTM C1293) testing limits of Section 5.1 of “Guide Specification for Concrete Subject to Alkali-Silica Reactions” (2007 Portland Cement Association). When aggregates are “potentially reactive”, compliance with Section 5.2 of “Guide Specification for Concrete Subject to Alkali-Silica Reactions” (2007 Portland Cement Association) must be established through ASTM C1567 testing for proposed alternate concrete mixture. Submit test reports in accordance with Part I of this specification.
2.14 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI’s “Manual of Standard Practice.”

2.15 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 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. Concrete adjacent to elevators shall be installed within the tolerances required by the elevator manufacturer.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

   1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
   2. The permissible irregularity is a cumulative value due to all sources of error including, but not limited to, layout, plumbness, member sizes, formwork offsets, joints, and member levelness.

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. All formwork surfaces that will provide the finish surface of exposed concrete must be accepted by the Architect before depositing concrete.

3.2 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. 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" and with the following additional requirements:

   a. Tolerance of embedded items: Comply with ACI 117 and the following additional requirements:

      1) Embedded Plates and Weldment:
         a) Location: \( \pm 1" \) vertical, \( \pm 1" \) horizontal.

   b. Plumb and alignment: \( 1/4" \) in 12".

2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3. Install dovetail anchor slots in concrete structures. Where masonry wall or veneer abuts concrete, provide one vertical dovetail slot for each 8" of masonry thickness. Where concrete serves as backup, space slots at 16 inches on center.

3.3 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 (10 deg C) 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.
3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

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

D. Size, length, number, and placing of supports shall be sufficient to hold reinforcing in the proper position within specified tolerances during construction traffic and concrete placement.

E. On vertical formwork, use approved bar chairs or spacers as required to maintain proper concrete cover and bar position. Do not staple or use any other metallic fastener to secure bolsters, chairs, etc. to formwork for concrete surfaces exposed to the exterior.

   1. Weld reinforcing bars according to AWS D1.4, where indicated.

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

G. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

H. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

3.5 JOINTS

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

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.

   2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.

   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.

   5. Space vertical joints in walls as indicated. Locate joints beside near corners, and in concealed locations where possible. Locate at centerline of support or in middle third of span.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shutterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
3. Interior Slabs-on-Grade to Receive Carpet or Wood Flooring: Construct slabs in as large a placement area as practical. Unless noted otherwise on the drawings, locate construction joints on column centerlines. Provide control joints at column centerlines and at intervals not more than 30 feet each way.
4. All other Interior Slabs-on-Grade: Unless noted otherwise on the drawings, locate construction joints on column centerlines. Locate control joints where shown on the drawings. If not shown, provide control joints at column centerlines and at intervals not more than 10 feet each way.

D. Isolation Joints in Slabs-on-Grade: 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. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Joints in Slabs-on Metal Deck: Locate construction joints as noted on the drawings. For metal deck slabs with WWF, continue WWF through the construction joint and lap in the adjacent pour. For metal deck slabs without WWF provide #4x4'-0 at 12 inches on center staggered 1'-0 at construction joints. Do not provide control joints.

F. Topping Slabs Exposed to View: Locate control joints where shown on the drawings. If not shown, locate topping slab control joints at column centerlines, over girders, and at intervals not exceeding 10' each way.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. 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.

D. 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. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.
C. Related Uniformed Surfaces: At tops of walls, horizontal offsets, and similar uniformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent uniformed surfaces, unless otherwise indicated.

3.8 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. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, paint, or another thin-film-finish coating system.

2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:

3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-foot-(3.05-m-) long straightedge resting on 2 high spots and placed anywhere on the surface does not exceed 3/16 inch (4.8 mm).

C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. 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: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.
3.10 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 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 (1 kg/sq. m 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. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

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 (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

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

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer’s written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
3.11 CONCRETE SURFACE REPAIRS

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

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spills, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning and that are unacceptable to the Architects. Allow Architect/Engineer to observe formed concrete surfaces immediately upon removal of forms and prior to repair of surface defects. Defects in structural concrete shall be brought to the attention of the Architect/Engineer. Repair tie holes and surface defects immediately after such observation. Where the concrete surface will be textured by sandblasting or bush-hammering, repair surface defects before texturing.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension in solid concrete, but not less than 1 inch (25 mm) in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. 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 will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template. Submit proposed repair for acceptance prior to beginning this work.

1. Repair finished surfaces containing defects that are unacceptable to the Architect. Surface defects include spills, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Submit proposed repair for acceptance prior to beginning this work.

4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

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.
3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Inspections:

1. Steel reinforcement placement embeds, and mechanical connectors.
   a. Inspect all reinforcing, verifying type of reinforcing, bar sizes, spacings, number of bars, concrete cover to bars, bar locations, splices including splice location and lap splice length or mechanical connector, in place condition of coated bars, and method of support of reinforcing.
   b. Inspect embedded bolts, plates, and steel shapes. Verify that size and number of bolts or anchors/rebar, embedment, anchorage, use of specified template and general embedment locations are as specified. Welds to embedments shall be tested as specified in Section 05120.
   c. Welding of reinforcing steel, where permitted, shall be inspected as specified in Section 05120.
   d. Inspect partially embedded reinforcement, which is field bent, or field straightened. Verify that procedures specified in ACI-301-99 Section 3.3.2.8 – “Field Bending or Straightening” are followed. Inspect all field bent bars.
   e. Test rebar anchored into hardened concrete as specified in Section 05120 for adhesive anchors.

2. Mechanical Connectors: Perform all special inspections as defined in the code approval report for mechanical connectors. As a minimum the following are required:
   a. Continuously observe the installation of the first two splices for each type of mechanical connector. Verify all aspects of installation are in accordance with Manufacturer’s instructions and code approval report.
   b. Visually inspect 100% of completed connections to verify installation is in accordance with Manufacturer’s instructions and ICBO test report.
      1) If any tension test fails to meet project requirements, test additional mechanical connectors as required by the Architect/Engineer.

3. Steel reinforcement welding.
4. Headed bolts and studs.
5. Verification of use of required design mixture.
6. Concrete placement, including conveying and depositing. Inspect the first concrete placement of footings, stemwalls/gradebeams, slab-on-grade, and slab-on-metal deck. Inspect each truck for correct mix design, addition of water to each truck and subsequent mixing, cleanliness of forms, concrete vibration, concrete finishing, and concrete curing.
7. Curing procedures and maintenance of curing temperature.
8. Verification of concrete strength before removal of shores and forms from beams and slabs.
9. Temperature of In-Place Concrete: Owner’s Testing Agency shall measure and report maximum/minimum temperature of in-place concrete during curing period when concreting in cold weather.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) or fraction thereof of each concrete mixture placed each day. Obtain one composite sample for each 50 yd³ for concrete having a specified 28-day strength greater than 5000 psi. Obtain one sample for each 5000 square feet of shearwalls or slabs.
   a. When frequency of testing will provide 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 C 143/C 143M; 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. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample at point of placement, but not less than one test for each day's pour of each concrete mixture.
   a. Where concrete will be exposed to deicing salts, air content tests will be made on samples from the first three batches in the placement and until three consecutive batches have air contents within the range specified, at which time every fifth batch will be tested. This test frequency will be maintained until a batch is not within the range specified, at which time testing of each batch will be resumed until three consecutive batches have air contents within the range specified. These air content tests may be taken on composite samples or on samples from the batch at any time after discharge of two cubic feet of concrete.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.

5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

6. Compression Test Specimens: ASTM C 31/C 31M.
   a. Cast and laboratory cure four standard cylinder specimens for each composite sample.

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one cylinder at 7 days and one set of two specimens at 28 days. Hold one cylinder and test at 56 days if 28-day strength is not achieved.
   a. 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.

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 (3.4 MPa).

9. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests, concrete supplier & mix ID number. Also include amount of water added at site prior to sampling, ambient air temperature, and concrete wet unit weight. Include time concrete was batched and time when placement was finished.

10. 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.

11. Additional Tests: 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. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

D. Measure floor and slab flatness and levelness according to ASTM E 1155 (ASTM E 1155M) within 24 hours of finishing.

END OF SECTION 033000
SECTION 042000 - UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Face brick.
3. Stone trim units.
4. Mortar and grout.
5. Steel reinforcing bars.
7. Ties and anchors.
8. Embedded flashing.
9. Miscellaneous masonry accessories.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete" for installing dovetail slots for masonry anchors.
2. Division 04 Section "Exterior Stone Cladding" for exterior stone veneers and trim.
3. Division 05 Section "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
4. Division 05 Section "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.
5. Division 07 Section "Water Repellents" for water repellents applied to unit masonry.
6. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
   1. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.
1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
   1. Prism Test: For each type of construction required, according to ASTM C 1314.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:
   1. Product Certificates for Credit MR 5.1 and Credit MR 5.2: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.

C. Shop Drawings: For the following:
   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
   2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
   3. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
   4. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

D. Samples for Initial Selection:
   1. Face brick, in the form of straps of five or more bricks.
   2. Stone trim.
   3. Colored mortar.
   4. Weep holes/vents.

E. Samples for Verification: For each type and color of the following:
   1. Face brick, in the form of straps of five or more bricks.
   2. Stone trim.
   3. Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.
   4. Weep holes and vents.
   5. Accessories embedded in masonry.

F. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers’ product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

   1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

G. Qualification Data: For testing agency.

H. Material Certificates: For each type and size of the following:
1. Masonry units.
   a. Include material test reports substantiating compliance with requirements.
   b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
   c. For exposed brick, include test report for efflorescence according to ASTM C 67.
   d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
7. Anchors, ties, and metal accessories.

I. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

J. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of typical wall area as shown on Drawings.
   2. Build mockups for typical exterior wall, full thickness, including face and backup wythes and accessories.
      a. Include a sealant-filled joint at least 16 inches (400 mm) long in each, exterior wall mockup.
b. Include lower corner of window opening framed with stone trim at upper corner of exterior wall mockup. Make opening approximately 12 inches (300 mm) wide by 16 inches (400 mm) high.

c. Include through-wall flashing installed for a 24-inch (600-mm) length in corner of exterior wall mockup approximately 16 inches (400 mm) down from top of mockup, with a 12-inch (300-mm) length of flashing left exposed to view (omit masonry above half of flashing).

d. Include metal studs, waterproofing, veneer anchors, flashing, cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.

3. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.

4. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.

5. Protect accepted mockups from the elements with weather-resistant membrane.

6. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

   a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.

   b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

7. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
1. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.


PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Regional Materials: Provide CMUs that have been manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

C. CMUs: ASTM C 90.

1. Unit Compressive Strength: Shown on Structural Drawings.
2. Density Classification: Shown on Structural Drawings.

2.3 CONCRETE AND MASONRY LINTELS

A. General: Provide one of the following:

B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Division 03 Section "Cast-in-Place Concrete," and with reinforcing bars indicated.

D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 BRICK

A. Regional Materials: Provide brick that has been manufactured within 500 miles (800 km) of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
   1. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, and lintels.

C. Face Brick: Facing brick complying with ASTM C 216.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following: Misty Grey color, smooth texture, manufactured by Hebron Brick Company, distributed by Robinson Brick. Contact: Ken Silliman (303) 783-3000.
      a. Grade: SW.
      b. Type: FBS.
      c. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi.
      d. Initial Rate of Absorption: Less than 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67.
      e. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
      f. Size (Actual Dimensions): As shown on Drawings.
2.5 STONE TRIM UNITS

A. Limestone: ASTM C 568, Match existing density.

2.6 MORTAR AND GROUT MATERIALS

A. Regional Materials: Provide aggregate for mortar and grout, cement, and lime that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.

B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

C. Hydrated Lime: ASTM C 207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      a. Davis Colors; True Tone Mortar Colors.
      b. Lanxess Corporation; Bayferrox Iron Oxide Pigments.
      c. Solomon Colors, Inc.; SGS Mortar Colors.

F. Colored Cement Product: Packaged blend made from portland cement and hydrated lime or and mortar pigments, all complying with specified requirements, and containing no other ingredients.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      a. Colored Portland Cement-Lime Mix:

         2) Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
         4) Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

   2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.

   3. Pigments shall not exceed 10 percent of portland cement by weight.

G. Aggregate for Mortar: ASTM C 144.

   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
   3. White-Mortar Aggregates: Natural white sand or crushed white stone.
   4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

I. Cold-Weather Admixture: Accelerating admixture will not be allowed. Antifreeze will not be allowed.

J. Water: Potable.

2.7 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:

1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches (100 mm) wide, plus 1 side rod 2 side rods at each wythe of masonry 4 inches (100 mm) wide or less.

2.8 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

2. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.

B. Corrugated Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 7.6 to 12.7 mm and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from 0.060-inch- (1.52-mm-) thick, steel sheet, galvanized after fabrication.

C. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.

D. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.

1. Wire: Fabricate from 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire. Mill-galvanized wire ties may be used in interior walls unless otherwise indicated.

E. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.25-inch- (6.35-mm-) diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

F. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
   a. Structural Performance Characteristics: Capable of withstanding a 100-lbf (445-N) load in both tension and compression without deforming or developing play in excess of 0.05 inch (1.3 mm).

2. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Dayton Superior Corporation, Dur-O-Wal Division; D/A 213 or D/A 210 with D/A 700-708.
   b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, 2-3/4 inches (70 mm) wide by 3 inches (76 mm) high; with projecting tabs having slotted holes for inserting vertical legs of wire tie specially formed to fit anchor section.
   c. Anchor Section: Sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom and with raised rib-stiffened strap, 5/8 inch (16 mm) wide by 3-5/8 inches (92 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie.
   d. Anchor Section: Gasketed sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (152 mm) long, with screw holes top and bottom; top and bottom ends bent to form pronged legs of length to match thickness of insulation or sheathing; and raised rib-stiffened strap, 5/8 inch (16 mm) wide by 6 inches (152 mm) long, stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and extend beyond pronged legs.
   e. Anchor Section: Corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed, washer head that covers hole in sheathing.
   f. Fabricate sheet metal anchor sections and other sheet metal parts from 0.075-inch- (1.90-mm-) thick, steel sheet, galvanized after fabrication.
   g. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.

3. Slip-in, Masonry-Veneer Anchors: Units consisting of a wire tie section and an anchor section designed to interlock with metal studs and be slipped into place as sheathing is installed.
   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      1) Hohmann & Barnard, Inc.; AA308.
   b. Wire-Type Anchor: Bent wire anchor section with an eye to receive the wire tie. Wire tie has a vertical leg that slips into the eye of anchor section and allows vertical adjustment. Both sections are made from 3/16-inch (4.76-mm), hot-dip galvanized wire.
2.9 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch (0.86-mm), galvanized steel sheet.

C. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

D. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 unless otherwise indicated.


2.10 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA’s “Architectural Sheet Metal Manual” and Division 07 Section “Sheet Metal Flashing and Trim™” and as follows:

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Copper-Laminated Flashing: 5-oz./sq. ft. (1.5-kg/sq. m) 7-oz./sq. ft. (2-kg/sq. m) copper sheet bonded between 2 layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) Advanced Building Products Inc.; Copper Fabric Flashing, Copper Sealite 2000.
      2) Dayton Superior Corporation, Dur-O-Wal Division; Copper Fabric Thru-Wall Flashing.
      3) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
      4) Phoenix Building Products; Type FCC-Fabric Covered Copper.
      5) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
      6) York Manufacturing, Inc.; Multi-Flash 500.

2. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 20 mls thickness.

   a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

      1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.
      2) Firestone Specialty Products; FlashGuard.
      3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.
      4) Hohmann & Barnard, Inc.; Epara-Max EPDM Thru-Wall Flashing.
5) Sandell Manufacturing Co., Inc.; EPDM Flashing.

C. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge, with a sealant stop, or flexible flashing with a metal drip edge, or flexible flashing with a metal sealant stop.
4. Where flashing is fully concealed, use flexible flashing.

D. Solder and Sealants for Sheet Metal Flashings: As specified in Division 07 Section "Sheet Metal Flashing and Trim."
   1. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant, of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.11 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65-406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use one of the following unless otherwise indicated:
   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe, in color selected from manufacturer's standard.
      a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
         1) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Advanced Building Products Inc.; Mortar Break, Mortar Break II.
      b. Archovations, Inc.; CavClear Masonry Mat.
      c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
      d. Mortar Net USA, Ltd.; Mortar Net.

2. Provide one of the following configurations:
a. Strips, full-depth of cavity and 10 inches (250 mm) high, with dovetail shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.
b. Strips, not less than 3/4 inch (19 mm) thick and 10 inches (250 mm) high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
c. Sheets or strips full depth of cavity and installed to full height of cavity.
d. Sheets or strips not less than 3/4 inch (19 mm) thick and installed to full height of cavity with additional strips 4 inches (100 mm) high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
   c. Holmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
   d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.12 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Diedrich Technologies, Inc.
   b. EaCo Chem, Inc.
   c. ProSoCo, Inc.

2.13 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For reinforced masonry, use Type S.
2. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
3. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
1. For stone setting mortar, add one (1) pound dark buff colored pigment to each sack of cement.
2. Pigments shall not exceed 10 percent of portland cement by weight.
3. Mix to match existing.

E. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
3. Provide grout with a slump of 8 to 11 inches (203 to 279 mm) as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

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

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
   4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
   5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
   6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
   7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm) except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
   1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
   2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
   3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
   4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm). Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch (3 mm).
   5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch (1.5 mm) from one masonry unit to the next.
3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Match existing at corners or jambs.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

H. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch (13-mm) clearance between end of anchor rod and end of tube. Space anchors 48 inches (1200 mm) o.c. unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Division 07 Section "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow brick and CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

1. For glazed masonry units, use a nonmetallic jointer 3/4 inch (19 mm) or more in width.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 COMPOSITE MASONRY

A. Bond wythes of composite masonry together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. (0.25 sq. m) of wall area spaced not to exceed 24 inches (610 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (914 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.

   a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.


   a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.

   b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.

3. Header Bonding: Provide masonry unit headers extending not less than 3 inches (76 mm) into each wythe. Space headers not over 8 inches (203 mm) clear horizontally and 16 inches (406 mm) clear vertically.

B. Bond wythes of composite masonry together using bonding to match existing.

C. Collar Joints: Solidly fill collar joints by parging face of first wythe that is laid and shoving units of other wythe into place.

D. Corners: Provide interlocking masonry unit bond in each wythe and course at corners unless otherwise indicated.

1. Provide continuity with masonry joint reinforcement at corners by using prefabricated L-shaped units as well as masonry bonding.

E. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:

   1. Provide rigid metal anchors not more than 24 inches (610 mm) o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

3.7 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:
1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. (0.25 sq. m) of wall area spaced not to exceed 24 inches (610 mm) o.c. horizontally and 16 inches (406 mm) o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches (305 mm) of openings and space not more than 36 inches (915 mm) apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches (610 mm) o.c. vertically.
   a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
   b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.

   a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
   b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
   c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.


B. Bond wythes of cavity walls together using bonding system indicated on Drawings.

C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

D. Coat cavity face of backup wythe to comply with Division 07 Section "Bituminous Dampproofing."

3.8 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).

   1. Space reinforcement not more than 16 inches (406 mm) o.c.
   2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.
3.9 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than 2 inches (50 mm) wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches (610 mm) o.c. vertically and 36 inches (915 mm) o.c. horizontally.

3.10 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten anchors to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
3. Embed tie sections, connector sections and continuous wire in masonry joints. Provide not less than 2 inches (50 mm) of air space between back of masonry veneer and face of sheathing.
4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
5. Space anchors as indicated, but not more than 18 inches (458 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. (0.2 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 8 inches (203 mm), around perimeter.
6. Space anchors as indicated, but not more than 16 inches (406 mm) o.c. vertically and 24 inches (610 mm) o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. (0.25 sq. m) of wall area. Install additional anchors within 12 inches (305 mm) of openings and at intervals, not exceeding 36 inches (914 mm), around perimeter.

3.11 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows using one of the following methods:

1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
2. Install preformed control-joint gaskets designed to fit standard sash block.
3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
4. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:

1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches (100 mm) in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch (10 mm) for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

3.12 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete or masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.13 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches (100 mm), and 1-1/2 inches (38 mm) into the inner wythe.
3. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under building paper or building wrap, lapping at least 4 inches (100 mm).
4. At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
3. Space weep holes 24 inches (600 mm) o.c. unless otherwise indicated.
4. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

5. Trim wicking material flush with outside face of wall after mortar has set.

E. Place pea gravel in cavities as soon as practical to a height equal to height of first course above top of flashing, but not less than 2 inches (50 mm), to maintain drainage.

F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

G. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.14 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

2. Limit height of vertical grout pours to not more than 60 inches (1520 mm).

3.15 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.

3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.
D. Testing Frequency: One set of tests for each 5000 sq. ft. (464 sq. m) of wall area or portion thereof.

E. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

3.16 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleansed for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
6. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
7. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
8. Clean stone trim to comply with stone supplier's written instructions.
9. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.17 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION 042000
SECTION 044200 - EXTERIOR STONE CLADDING

PART I - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following types of dimension stone:

1. Panels set with individual anchors.
2. Trim units, including bands. Refer to Division 04 Section “Unit Masonry”.

B. Related Sections include the following:

1. Division 04 Section "Unit Masonry" for installing inserts in unit masonry for anchoring dimension stone cladding and for stone trim in unit masonry walls.
2. Division 07 Section "Joint Sealants" for sealing joints in dimension stone cladding system with elastomeric sealants.

1.3 DEFINITIONS

A. Definitions contained in ASTM C 119 apply to this Section.

B. Dimension Stone Cladding System: An exterior wall covering system consisting of dimension stone panels and trim together with anchors, backup structure, secondary weather barrier, mortar, fasteners, and sealants used to secure the stone to building structure and to produce a weather-resistant covering.

1.4 PERFORMANCE REQUIREMENTS

A. General: Design stone anchors and anchoring systems according to ASTM C 1242.

B. Structural Performance: Provide dimension stone cladding system capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Wind Loads: Refer to Structural Drawings.

C. Thermal Movements: Provide dimension stone cladding system that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing displacement of stone, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient: 180 deg F (100 deg C), material surfaces.
D. Horizontal Building Movement (Interstory Drift): Allow for maximum horizontal building movement equal to quotient resulting from dividing floor-to-floor height at any floor by 400.

E. Shrinkage and Creep: Allow for progressive vertical shortening of building frame equal to 1/8 inch in 10 feet (3 mm in 3 m).

F. Safety Factors for Stone: Design dimension stone cladding system to withstand loads indicated without exceeding allowable working stress of stone determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:

G. Design stone anchors to withstand loads indicated without exceeding allowable working stresses established by the following:
   1. For Post-Installed Fasteners in Masonry: One-sixth of tested capacity when installed in masonry units indicated.

H. Provision for Deflection of Building Structure: Allow for the following:
   1. Deflection due to Weight of Dimension Stone Cladding System: Allow for 1/4-inch (6-mm) vertical deflection in 20-foot (6-m) span of structural members supporting dimension stone cladding system.
   2. Live Load Deflection: Allow for 1/4-inch (6-mm) vertical deflection, in 20-foot (6-m) span of structural members supporting dimension stone cladding system, due to live loads imposed on building's structural frame after stone installation.

I. Leakage Resistance, Water and Air: Provide dimension stone cladding system that complies with the following:
   1. Air Infiltration: Not more than 0.004 cfm/sq. ft. (0.02 L/s per sq. m) of wall area, as measured by testing mockup per ASTM E 283 at a differential pressure of 1.57 lbf/sq. ft. (75 Pa).
   2. Water Penetration: No uncontrolled water penetration beyond plane of back of dimension stone cladding system that is not contained or drained back to exterior, as measured by testing mockup per ASTM E 331 at a differential pressure of 20 percent of positive design wind load, but not less than 10 lbf/sq. ft. (479 Pa).

J. Control of Corrosion and Staining: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Use materials that do not stain exposed surfaces of stone and joint materials.

1.5 SUBMITTALS

A. Product Data: For each variety of stone, stone accessory, and other manufactured products indicated.

B. Shop Drawings: Show fabrication and installation details for dimension stone cladding system, including dimensions and profiles of stone units.
   1. Show locations and details of joints both within dimension stone cladding system and between dimension stone cladding system and other construction.
   2. Include details of mortar joints, sealant joints, and mortar joints pointed with sealant.
   3. Show locations and details of anchors and backup structure.
   4. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
C. Stone Samples for Verification: Sets for each color, grade, finish, and variety of stone required; not less than 12 inches (300 mm) square.
   1. Sets shall consist of at least three Samples, exhibiting extremes of the full range of color and other visual characteristics expected and will establish the standard by which stone will be judged.

D. Colored Pointing Mortar Samples for Verification: For each color required, showing the full range of exposed color and texture expected in the completed Work.

E. Sealant Samples for Verification: For each type and color of joint sealant required.

F. Qualification Data: For Installer, fabricator, professional engineer and testing agency.

G. Material Test Reports: From a qualified independent testing agency, as follows:
   1. Stone Test Reports: For each stone variety proposed for use on Project, provide test data indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous five years.
   2. For metal components, indicate chemical and physical properties of metal.
   3. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer complying with requirements in Division 07 Section "Joint Sealants" and indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

H. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual experienced in installing dimension stone cladding systems similar in material, design, and extent to that indicated for this Project, whose work has a record of successful in-service performance.

B. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate dimension stone cladding systems similar to that required for this Project and whose products have a record of successful in-service performance.
   1. Fabricator’s responsibilities include fabricating dimension stone cladding and providing professional engineering services needed to assume engineering responsibility.
   2. Engineering Responsibility: Comprehensive engineering analysis by a qualified professional engineer.

C. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

D. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry, whether specified in this Section or in another Section of the Specifications, with resources to provide materials of consistent quality in appearance and physical properties.
   1. For stone types that include same list of varieties and sources, provide same variety from same source for each.
   2. Make quarried blocks available for examination by Architect for appearance characteristics.
E. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from a single manufacturer and each aggregate from one source or producer.

F. Source Limitations for Other Materials: Obtain each type of stone accessory, sealant, and other material from a single manufacturer for each product.

G. Preconstruction Stone Testing: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner.

1. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
2. Furnish test specimens that are representative of materials proposed for incorporation into the Work.
3. Physical Property Tests: For each stone variety proposed for use on Project, tested for compliance with physical property requirements, other than abrasion resistance, according to referenced ASTM standards.
4. Flexural Strength Tests: For stone variety, thickness, orientation of cut, and finish, proposed for use on Project, tested according to ASTM C 880, in both wet and dry conditions.
5. Anchorage Tests: For stone variety, orientation of cut, finish, and anchor type proposed for use on Project, tested according to ASTM C 1354.
6. Anchoring System Mockup Tests: For performance of stone anchoring system, evaluated for compliance with requirements by mockup testing per ASTM C 1201, Procedure B, with a maximum test load equal to 3 times the design load.
7. Cladding System Mockup Tests: For performance of dimension stone cladding system, evaluated for compliance with requirements by mockup testing per ASTM E 72, with a maximum test load equal to 3 times the design load.
8. Contractor is required to build test mockups of representative portion of dimension stone cladding system corresponding to area indicated on Drawings. Build test mockups at testing agency's facilities from same materials proposed for Project, using installers who will perform same tasks for Project.
9. Testing agency will report test results in writing to Architect and Contractor.

H. Preconstruction Sealant Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for compatibility and adhesion testing according to sealant manufacturer's standard testing methods and Division 07 Section "Joint Sealants," samples of materials that will contact or affect joint sealants.

I. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of typical wall area as shown on Drawings.
2. Build mockups of typical exterior wall with dimension stone cladding, approximately 15 feet (4.5 m) long by 10 feet (3 m) high.
   a. Show typical components, attachments to building structure, and methods of installation.
   b. Include window opening with stone trim.
   c. Include sealant-filled joint complying with requirements in Division 07 Section "Joint Sealants."

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, and other causes.

1. Lift stone with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.

B. Mark stone units, on surface that will be concealed after installation, with designations used on Shop Drawings to identify individual stone units. Orient markings on vertical panels so that they are right side up when units are installed.

C. Deliver sealants to Project site in original unopened containers labeled with manufacturer’s name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.

D. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

E. Store aggregates in locations where grading and other required characteristics can be maintained and where contamination can be avoided.

1.8 PROJECT CONDITIONS

A. Protect dimension stone cladding during erection as follows:

1. Cover tops of dimension stone cladding installation with nonstaining, waterproof sheeting at end of each day’s work. Cover partially completed structures when work is not in progress. Extend cover a minimum of 24 inches (600 mm) down both sides and hold securely in place.
2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging stone.
3. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on ground and over wall surface.
4. Protect sills, ledges, and projections from mortar and sealant droppings.

B. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Remove and replace dimension stone cladding damaged by frost or freezing conditions.

2. Cold-Weather Construction: When ambient temperature is within limits indicated, use the following procedures:
   a. At 40 deg F (5 deg C) and below, produce mortar temperatures between 40 and 120 deg F (5 and 49 deg C) by heating mixing water, sand, or both. Do not heat water to above 160 deg F (71 deg C).
3. Cold-Weather Protection: When mean daily temperature is within limits indicated, provide the following protection for 48 hours after construction:
   a. 40 to 25 Deg F (Plus 5 to Minus 4 Deg C): Cover dimension stone cladding with a weather-resistant membrane.

D. Environmental Limitations for Sealants: Do not install sealants when ambient and substrate temperatures are outside limits permitted by sealant manufacturer or below 40 deg F (5 deg C) or when joint substrates are wet.

1.9 COORDINATION

A. Coordinate installation of inserts that are to be embedded in concrete or masonry, flashing reglets, and similar items to be used by dimension stone cladding Installer for anchoring, supporting, and flashing of dimension stone cladding system. Furnish setting drawings, templates, and directions for installing such items and deliver to Project site in time for installation.

B. Time delivery and installation of dimension stone cladding to avoid extended on-site storage and to coordinate with work adjacent to dimension stone cladding.

PART 2 - PRODUCTS

2.1 LIMESTONE

A. Limestone: Comply with ASTM C 568.

B. Match Limestone on existing building.

C. Thickness: Match existing.

2.2 QUARTZ-BASED STONE

A. Quartz-Based Stone: Comply with ASTM C 616, Classification I Sandstone.

B. Varieties and Sources: Subject to compliance with requirements, provide one of the following:

C. Variety and Source: Subject to compliance with requirements, provide the following:

1. Sandstone to match sandstone on existing building from Lyons, Colorado quarries.

2. Match for color, finish, and other stone characteristics relating to aesthetic effects.

D. Thickness: Match existing.

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

1. Low-Alkali Cement: Portland cement for use with limestone shall contain not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207.
C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.

D. Colored Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III; hydrated lime complying with ASTM C 207; and mortar pigments. Use a mix of formulation required to produce color indicated or, if not indicated, as selected from manufacturer's standard formulations. Pigments shall not exceed 10 percent of portland cement by weight.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   a. Essroc, Italcemienti Group; Capitol PCL, Blend or Saylor's Plus.
   b. Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
   c. Lafarge North America Inc.; Eaglebond.
   d. Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

E. Aggregate: ASTM C 144; except for joints narrower than 1/4 inch (6 mm) and pointing mortar, use aggregate graded with 100 percent passing No. 16 (1.18-mm) sieve.

F. Mortar Pigments: Natural and synthetic iron oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in mortar and containing no carbon black.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   b. Davis Colors; True Tone Mortar Colors.
   c. Solomon Colors; SGS Mortar Colors.

G. Water: Potable.

2.4 ANCHORS AND FASTENERS

A. Fabricate anchors from stainless steel, ASTM A 666, Type 304, temper as required to support loads imposed without exceeding allowable design stresses. Fabricate dowels and pins for anchors from stainless steel, ASTM A 276, Type 304.

B. Cast-in-Place Concrete Inserts: Steel, cast iron, or malleable iron adjustable inserts, with bolts, nuts, washers, and shims; all hot-dip galvanized or mechanically zinc coated, with capability to sustain, without failure, a load equal to 4 times the loads imposed as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

C. Postinstalled Anchor Bolts for Concrete and Masonry: Chemical anchors torque-controlled expansion anchors or undercut anchors made from stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Alloy Group A1 or A4) for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

D. Threaded Fasteners: Heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.

1. For stainless steel, use annealed stainless-steel bolts, nuts, and washers; ASTM F 593 (ASTM F 738M) for bolts; and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1) 2 (A4).
2. For galvanized steel shelf angles and backup structure, use carbon steel bolts, nuts, and washers; ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6), for bolts; ASTM A 563 (ASTM A 563M), Grade A, for nuts; and ASTM F 436 (ASTM F 436M) for washers; all hot-dip or mechanically zinc coated.

E. Weld Plates for Installation in Concrete: Comply with Division 05 Section "Metal Fabrications."

2.5 STONE ACCESSORIES

A. Setting Shims: Strips of resilient plastic or vulcanized neoprene, Type A Shore durometer hardness of 50 to 70, nonstaining to stone, of thickness needed to prevent point loading of stone on anchors and of depths to suit anchors without intruding into required depths of pointing materials.

B. Setting Buttons: Resilient plastic buttons, nonstaining to stone, sized to suit joint thicknesses and bed depths of stone units without intruding into required depths of pointing materials.

C. Concealed Flashing: Fabricate from self adhesive elastomeric material stainless steel in thicknesses indicated, but not less than 0.0156 inch (0.4 mm) thick. Comply with requirements specified in Division 07 Section "Sheet Metal Flashing and Trim."

D. Cementitious Dampproofing for Limestone: Provide cementitious formulations that are recommended by ILI and that are nonstaining to stone, compatible with joint sealants, and noncorrosive to anchors and attachments.

E. Weep and Vent Tubes: As specified in Section 042000 “Unit Masonry” and of length required to extend from exterior face of stone to cavity behind.

F. Sealants for Joints in Dimension Stone Cladding: Manufacturer’s standard chemically curing, elastomeric sealants of base polymer and characteristics indicated below that comply with applicable requirements in Division 07 Section “Joint Sealants” and do not stain stone.

2. Colors: Provide colors of exposed sealants to comply with the following requirement:
   a. Match color of mortar: Test before using to assure no staining of stone.

2.6 STONE FABRICATION

A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.

1. For limestone, comply with recommendations in ILI’s "Indiana Limestone Handbook."

B. Control depth of stone and back check to maintain minimum clearance of 1 inch (25 mm) between backs of stone units and surfaces or projections of structural members, fireproofing (if any), backup walls, and other work behind stone.

C. Dress joints (bed and vertical) straight and at right angle to face, unless otherwise indicated. Shape beds to fit supports.

D. Cut and drill sinkages and holes in stone for anchors, fasteners, supports, and lifting devices as indicated or needed to set stone securely in place.

E. Finish exposed faces and edges of stone, except sawed reveals, to comply with requirements indicated for finish and to match approved samples and mockups.
F. Cut stone to produce uniform joints to match existing stone work wide and in locations indicated.

G. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous work.

H. Clean backs of stone to remove rust stains, iron particles, and stone dust.

I. Inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
   1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.

2.7 MORTAR MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce mortar of uniform quality and with optimum performance characteristics.
   1. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. Do not use calcium chloride.
   2. Combine and thoroughly mix cementitious materials, water, and aggregates in a mechanical batch mixer, unless otherwise indicated. Discard mortar when it has reached initial set.

B. Portland Cement-Lime Setting Mortar: Comply with ASTM C 270, Proportion Specification, for types of mortar indicated below:
   1. Set limestone with Type N mortar.
   2. Set quartz-based stone with Type N mortar.

C. Pointing Mortar: Comply with ASTM C 270, Proportion Specification, for types of mortar indicated. Provide pointing mortar mixed to match Architect's sample and complying with the following:
   2. Colored-Aggregate Pointing Mortar: Produce color required by combining colored aggregates with portland cement of selected color.
   3. Point limestone with Type N mortar.
   4. Point quartz-based stone with Type N mortar.

2.8 SOURCE QUALITY CONTROL

A. Source Quality-Control Testing Service: Owner will employ an independent testing agency to perform source quality-control testing indicated below. Payment for these services will be made by Owner.

B. Source Quality-Control Testing Service: Engage a qualified independent testing agency to perform source quality-control testing indicated below.
   1. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
   2. Furnish test specimens randomly selected from same blocks as actual materials proposed for incorporation into the Work.
3. Flexural Strength Tests: ASTM C 880, performed on specimens of same thickness, orientation of cut, and finish as installed stone. One set of test specimens is required to be tested for every 3000 sq. ft. (300 sq. m), but not fewer than 2 sets for each stone variety.

C. Testing agency will report test results in writing to Architect and Contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive dimension stone cladding and conditions under which dimension stone cladding will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of dimension stone cladding.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING DIMENSION STONE CLADDING, GENERAL

A. Before setting stone clean surfaces that are dirty or stained by removing soil, stains, and foreign materials. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

B. Coat limestone with dampproofing to extent indicated below:

1. Stone at Grade: Beds, joints, and back surfaces to at least 12 inches (300 mm) above finish-grade elevations.
2. Stone Extending below Grade: Beds, joints, back surfaces, and face surfaces below grade.
3. Allow cementitious dampproofing formulations to cure before setting dampproofed stone. Do not damage or remove dampproofing while handling and setting stone.

C. Execute dimension stone cladding installation by skilled mechanics and employ skilled stone fitters at Project site to do necessary field cutting as stone is set.

1. Use power saws with diamond blades to cut stone. Produce lines cut straight and true, with edges eased slightly to prevent snipping.

D. Contiguous Work: Provide openings as required to accommodate contiguous work.

E. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure dimension stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.

F. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated.
1. Keep expansion joints free of mortar and other rigid materials.

G. Install concealed flashing at continuous shelf angles, lintels, ledges, and similar obstructions to downward flow of water to divert water to building exterior.
H. Keep cavities open where unfilled space is indicated between back of stone units and backup wall; do not fill cavities with mortar or grout.

1. Place weep holes in joints where moisture may accumulate, including base of cavity walls, above shelf angles, and flashing. Locate weep holes at intervals not exceeding 24 inches (600 mm).
2. Place vents in cavity walls at tops of cavities, below shelf angles and flashing, and at intervals not exceeding 20 feet (6 m) vertically. Locate vents in joints at intervals not exceeding 60 inches (1500 mm) horizontally.

3.3 SETTING MECHANICALLY ANCHORED DIMENSION STONE CLADDING

A. Attach anchors securely to stone and to backup surfaces. Comply with recommendations in ASTM C 1242.

B. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with sealant indicated for filling kerfs.

C. Set stone supported on clips or continuous angles on resilient setting shims. Use material of thickness required to maintain uniform joint widths and to prevent point loading of stone on anchors. Hold shims back from face of stone a distance at least equal to width of joint.

3.4 JOINT-SEALANT INSTALLATION

A. Prepare joints and apply sealants of type and at locations indicated to comply with applicable requirements in Division 07 Section "Joint Sealants."

3.5 INSTALLATION TOLERANCES

A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (10 mm in 6 m), or 1/2 inch in 40 feet (12 mm in 12 m) or more. For external corners, corners and jambs within 20 feet (6 m) of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch in 40 feet (10 mm in 12 m) or more.

B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 3/8 inch (10 mm) maximum.

C. Variation of Linear Building Line: For positions shown in plan and related portions of walls and partitions, do not exceed 1/4 inch in 20 feet (6 mm in 6 m) or 1/2 inch in 40 feet (12 mm in 12 m) or more.

D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch (6 mm).

E. Variation in Joint Width: Do not vary from average joint width more than plus or minus 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less. For joints within 60 inches (1500 mm) of each other, do not vary more than 1/8 inch (3 mm) or a quarter of nominal joint width, whichever is less from one to the other.

F. Variation in Plane between Adjacent Stone Units (Lipping): Do not exceed 1/16-inch (1.5-mm) difference between planes of adjacent units.
3.6 FIELD QUALITY CONTROL

A. Field Quality-Control Water Leakage Test: Test dimension stone cladding system according to AAMA 501.2.
   1. Notify Architect seven days in advance of dates and times when testing will be done.
   2. Perform test at two locations as directed by Architect.
   3. Report test results in writing to Architect and Owner.

3.7 ADJUSTING AND CLEANING

A. Remove and replace broken, chipped, stained, or otherwise damaged stone, defective joints, and dimension stone cladding that does not match approved samples and mockups. Damaged stone may be repaired if Architect approves methods and results.

B. Replace in a manner that results in dimension stone cladding's matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.

C. In-Progress Cleaning: Clean dimension stone cladding as work progresses. Remove mortar fins and smears before tooling joints. Remove excess sealant and smears as sealant is installed.

D. Final Cleaning: Clean dimension stone cladding no fewer than six days after completion of pointing and sealing, using clean water and stiff-bristle fiber brushes. Do not use wire brushes, acid-type cleaning agents, cleaning agents containing caustic compounds or abrasives, or other materials or methods that could damage stone.

END OF SECTION 044200
SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Structural steel.
2. Grout.

B. Related Sections include the following:

1. Division 01 Section "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Division 05 Section "Steel Decking" for field installation of shear connectors.
3. Division 05 Section "Metal Fabrications" for steel lintels or shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other metal items not defined as structural steel.
4. Division 09 painting Sections for surface preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.4 PERFORMANCE REQUIREMENTS

A. Connections

1. Provide connections as shown or noted on drawings. The design of connections not shown or noted shall be provided by the Structural Engineer-of-Record upon request.
2. Alternate connections designed by the Contractor’s Engineer may be submitted with one set of stamped calculations for record. All alternate connections shall be designed for the value noted on plan. The Contractor shall compensate the Structural Engineer-of-Record for time spent reviewing alternate connection designs and revising Contract Documents.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

C. Erection Drawings:

1. Submit erection drawings defining location of each assembly or piece within the structure. Provide sufficient details to describe all field welding. Clearly identify all high strength bolts not required to be tensioned ("snug tight" as defined by AISC). If drawings are submitted in multiple packages, each submittal shall be complete with all erection drawings, details and piece drawings. Subsequent submittals of erection drawings which modify or add to earlier versions will be clearly marked.
2. Submit setting drawings for bolts and plates installed by others.
3. Reproduction of the Contract Documents is not permitted. Electronic CAD and/or analysis files will not be made available to the Contractor upon request.

D. Welding certificates.

E. Qualification Data: For Installer and fabricator

F. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:

1. Structural steel including chemical and physical properties.
2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
3. Direct-tension indicators.
4. Tension-control, high-strength bolt-nut-washer assemblies.
5. Shear stud connectors.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Sbd.

C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

D. Fabrication and erection shall comply with applicable provisions of the following specifications and documents:
   a. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
   4. AISC's "Specification for the Design of Steel Hollow Structural Sections."
   5. AISC's "Specification for Allowable Stress Design of Single-Angle Members"
   6. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

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E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, Dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 COORDINATION

A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M

B. Channels, Angles: ASTM A 36/A 36M

C. Plate and Bar: ASTM A 36/A 36M

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B C, structural tubing.

E. Welding Electrodes: Comply with AWS requirements, 70 Series.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.


C. Rebar: Rebar used for welding shall meet the requirements of ASTM A-706. Rebar bends shall meet the minimum bend diameters listed in the ACI 318, latest edition.

1. Interior Use: For use in conditioned environments free from potential moisture, provide carbon steel anchors conforming to ASTM A307 with zinc plating in accordance with FS 22-Z-235.

2. Exterior or Exposed Use: In exposed or potentially wet environments, and for attachment of exterior cladding materials, provide galvanized or stainless steel anchors. Galvanized anchors shall conform to ASTM A133. Stainless steel anchors shall be Series 300 stainless steel bolts with Series 300 or Type 18-8 stainless steel nuts and washers.

3. Where anchor Manufacturer is not indicated, subject to compliance with requirements and acceptance by the Architect and Structural Engineer-of-Record, provide one of the following:
   
a. “Kwik-Bolt 3” – Hilti Fastening Systems
b. “Parabolt” – Molly Fastener Group
c. “Red Head Wedge Anchor” – Phillips


1. Exterior or Exposed Use: In exposed or potentially wet environments and for attachment of exterior cladding materials, provide galvanized or stainless steel anchors. Galvanized anchors shall conform to ASTM A153. Stainless steel anchors shall be Series 300 stainless steel threaded rods with Series 300 or Type 18-8 stainless steel nuts and washers.

2. Where Anchor Manufacturer is not indicated, subject to compliance with requirements and acceptance by the Architect and Structural Engineer-of-Record, provide one of the following:
   
a. "HVA Adhesive Anchor” – Hilti Fastening Systems

2.3 PRIMER


B. Galvanizing Repair Paint: MPI#18, MPI#19.

2.4 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time. Where covered by earth, concrete or otherwise concealed from view 6000 psf minimum

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time. Where grout is exposed to view or weathering, 6000 psi

2.5 FABRICATION


1. Camber structural-steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning, SSPC-SP 2, "Hand Tool Cleaning, SSPC-SP 3, "Power Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
   1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
   2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

H. Splices: Splicing of members to obtain the required lengths will not be permitted without prior acceptance of the Structural Engineer-of-Record unless shown on the drawings.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: As noted on drawings.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
   1. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances
      a. Grind butt welds flush.
      b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.
B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

C. Priming: Immediately after surface preparation, apply primer according to manufacturer’s written instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.

1. Fill vent holes and grind smooth after galvanizing.
2. Galvanize lintels attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

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

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to 100% visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection percentages and procedures, at testing agency's option:

1. All full or partial penetration groove welded connections and splices: 100% ultrasonic.
2. All other welds: 10% magnetic particle.
3. For all complete and partial penetration groove welded connections and splices.

E. In addition to visual inspection, embedded plates and assemblies manufactured by the Steel Fabricator shall be tested and inspected according to requirements in AWS D1.1 for stud welding and as follows:

1. Assemblies supporting structural elements: 100%.
2. Assemblies supporting precast concrete or masonry wall elements: 60%.
3. Assemblies supporting curtain wall elements: 20%.

F. Test components of those embedded plates and assemblies to be tested as follows:

1. Welded reinforcing bars and deformed anchors: 100% visual and 10% magnetic particle.
   Complete penetration groove welds to reinforcing bars: 100% ultrasonic.
2. Stud connectors shall have all studs visually and acoustically tested. Studs which have visual defects and/or do not ring when struck with a hammer shall be tested by magnetic particle.

3. Plates:
   a. Embedded plates thicker than 3/8" shall be ultrasonically tested along the center line of the plate width. Such tests shall be made after stud/rebar shop welding.
   b. Any discontinuity shall be cause for rejection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

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

2. Contractor shall coordinate installation of all non-structural steel items which will load the non-self supporting structural steel frame. The structural steel frame temporary supports shall resist all loads from these non-structural steel items.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC’s "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design"


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

2. Weld plate washers to top of base plate.

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

4. Promptly pack grout solidly between bearing surfaces and base or bearing 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. Clean and moisten surfaces to be grouted. Remove all free water immediately prior to placing grout. Mix and install grout in accordance with Manufacturer’s instructions. Completely fill all spaces to be grouted.
After grout has acquired its initial set, trim to lower edge of bearing plate and remove excess material. Consolidate exposed edges to a dense uniform surface.


C. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. 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 is completed and in service.

D. Splice members only where indicated.

E. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.

F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

G. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: As noted on the drawings.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances of AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

C. Drilled-In Inserts: Install in accordance with Manufacturer’s recommendations in accurately drilled holes of required diameter and depth. Where adhesive inserts are used, thoroughly clean hole of all debris and drill dust by wire brushing and compressed air prior to installation of insert and adhesive system. Do not drill holes in concrete or masonry until material has achieved full design strength.
3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds, high-strength bolted connections and drilled-in inserts.

B. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC’s “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts”.

   1. Visually inspect all bolted connections (including bolts used to splice metal joists) to ascertain that all bolts, nuts and required washers have been installed and are of proper type and that all faying surfaces have been brought into snug contact. Verify the specified surface preparation of the faying surface has been correctly prepared.

   2. Tensioned High Strength Bolts:

      a. Standard Bolts:
         1) Inspect the bolt tightness of 10% of the bolts (minimum of 2), selected at random in each high strength bolted connection. If rejectable bolts are found in any connection, all remaining bolts in that connection shall be inspected for tightness. Inspection procedure shall be in accordance with “Specification for Structural Joints Using ASTM A325 or A490 Bolts” approved by Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation (Research Council on Structural Connections, latest edition).

      b. Twist Off (Self-Indicating) Bolts and Bolts With Direct Tension Indicator Washers:
         1) Perform a visual inspection of all high strength bolted connections to assure that all torque-off splines have been sheared. For bolts with Direct Tension Indicator Washers, inspect all washers with feeler gage to assure that all washers have been deformed the correct amount.

         2) When splines are not sheared, the Testing Agency shall determine that proper bolt tension has been achieved by the application of a properly calibrated testing torque or the Contractor may, at his option, remove and replace all bolts with unsheared splines. All cost of additional inspection required by this paragraph shall be borne by the Contractor.

C. Welded Connections: Field inspection of welding by the Testing Agency shall be such as to assure that the work conforms to specified requirements, and will include:

   1. Ascertainment that electrodes used for manual shielded metal-arc welding and the electrodes and flux used for submerged arc welding conform to the requirements herein.

   2. Ascertainment that the welding is performed only by welding operators and welders who are properly certified. The Testing Agency shall witness such qualification testing of welding operator and welders, as may be required.

   3. Ascertainment that the fit-up, joint preparation, size, contour, extent of reinforcement, and length and location of welds conform to specified requirements and the Contract Drawings, and that no specified welds are omitted or unspecified welds added without approval of the Structural Engineer-of-Record.

D. The Testing Agency shall test field welds as follows:

   1. All welds including curtain wall and shoring connections: 100% visual.

   2. All full or partial penetration groove welds: 100% ultrasonic.

   3. All other welds, including curtain wall and shoring connections: 10% magnetic particle.

   4. Stud connectors on composite beams shall be tested as follows:

      a. In addition to 100% visual inspection and the requirements on AWS D1.1 for stud welding, all studs shall be acoustically inspected. Studs which do not ring when struck with a
hammer shall be bent 15 degrees. If the bent stud does not fracture, stud is acceptable and may be left bent
b. In addition to the above, not less than one of each 100 studs shall be tested by bending 15
degrees. If no fracture occurs, stud is considered acceptable and left bent.

5. If defective welds are discovered, the remaining uninspected welds shall receive such ultrasonic or
magnetic particle inspection as may be required by the Structural Engineer-of-Record. All cost of
additional inspection required by this paragraph shall be borne by the Contractor.

6. The welding inspector will have the authority to reject weldments. Such rejection may be based on
visual inspection where in his opinion the weldment would not pass a more detailed investigation.

7. Reports by the Testing Agency’s Inspector will contain, as a minimum, an adequate description of
each weld tested, the identifying mark of the welder responsible for the weld, critique of any
defects noted by visual inspection or testing, and a statement regarding the acceptability of the
weld tested, as judged by current A.W.S. standards. Reports shall be distributed as early as
possible but not later than one workweek after the tests have been performed. The Structural
Engineer-of-Record shall be notified by phone if, in the judgment of the Inspector, test results
require immediate comment.

8. Radio graphic testing may be substituted for ultrasonic.

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

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

2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already
tested, according to requirements in AWS D1.1.

F. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract
Documents.

G. Drilled-in Anchors:

shown on the structural drawings as follows:

   a. Prior to installation, the Testing Agency shall determine that the installing contractor has
the proper materials and equipment for drilling holes in the receiving surface of required
diameter and length.

   b. All anchors shall be visually inspected after installation to ensure that they have been
installed perpendicular to the receiving surface and to proper depth.

   c. Pull test the first 3 and 1% of all remaining anchors for a tension load of 100% of the
Manufacturer’s recommended allowable working loads in tension.

2. Adhesive-Bonded Anchors/Rebar: The Testing Agency shall inspect adhesive-bonded, drilled-in
anchors as follows:

   The Testing Agency shall be present at the site to observe the installation of the first 50
anchors/rebar placed. Such observation shall be to ensure that drilled holes are of required
diameter and depth, holes are properly cleaned prior to installation of the anchors, and that holes
are completely filled with properly mixed adhesive after installation.

   a. All anchors/rebar shall be visually inspected after installation to ensure that the anchor has
been installed perpendicular to the receiving surface and to proper depth.

   b. Pull test the first 3 and 1% of all remaining anchors for a tension load of 100% of the
Manufacturer’s recommended allowable working loads in tension.
3.6 REPAIRS AND PROTECTION

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

B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

END OF SECTION 051200
SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Roof deck.
2. Composite floor deck.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for concrete fill.
2. Division 05 Section "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Division 05 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
4. Division 09 painting Sections for repair painting of primed deck.

1.3 SUBMITTALS

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

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

C. Stud Layout Drawings: Show number of studs per flute for beams. Show stud layout for all skewed girders. Show positions of studs in metal deck valleys.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

B. Fire-Test-Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.

C. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."


1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Steel Deck:
      a. ASC Profiles, Inc.
      c. Consolidated Systems, Inc.
      d. DACS, Inc.
      e. D-Mac Industries Inc.
      f. Epic Metals Corporation.
      g. Marlyn Steel Decks, Inc.
      h. New Millennium Building Systems, LLC.
      i. Nucor Corp.; Vulcraft Division.
      j. Roof Deck, Inc.
      k. United Steel Deck, Inc.
      l. Valley Joist; Division of EBSCO Industries, Inc.
      m. Verco Manufacturing Co.
      n. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "ANSI/SDI-RDI.0 Standard For Steel Roof Deck" in SDI Publication No. 31, and with the following:

   1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade as indicated. G60 (Z180) zinc coating. Use at exterior locations not exposed to view.
2. Deck Profile: As indicated
3. Profile Depth: As indicated
4. Design Uncoated-Steel Thickness: As indicated
5. Span Condition: As indicated.
6. Side Laps: Overlapped

2.3 COMPOSITE FLOOR DECK

A. Composite Steel Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "ANSI/SDI-C1.0 Standard For Composite Steel Floor Deck" in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
   1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade as indicated G60 (Z180) zinc coating. Use G90 (Z 275) where exposed to moisture.
   2. Profile Depth: As indicated
   3. Design Uncoated-Steel Thickness: As indicated
   4. Span Condition: As indicated

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 (4.8-mm) minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), not less than 0.0359-inch (0.91-mm) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi (230 MPa), of same material and finish as deck, and of thickness and profile indicated but not less than recommended by SDI Publication No. 31 for overhang and slab depth.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch (1.52 mm) 0.0747 inch (1.90 mm) thick, with factory-punched hole of 3/8-inch (9.5-mm) minimum diameter.

H. Galvanizing Repair Paint: ASTM A 780.

I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. When stud shear connectors are to be welded through metal deck the top flange of beams to receive such studs shall be unpainted and free of debris prior to installation of the deck.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

1. All openings through metal deck shown on the drawings, and other openings greater than 10” in any direction, shall be reinforced.

2. Miscellaneous openings not shown on the drawings such as those required for vents, risers, conduits, etc., shall be cut and reinforced if necessary, by the trade requiring the opening.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches (38 mm) long, self-drilling, self-tapping screws, as indicated.

1. Weld Diameter: As indicated.

2. Weld Spacing: Weld edge and interior ribs of deck units at each support as indicated.
3. **Weld Washers**: Install weld washers at each weld location when the minimum uncoated steel thickness is less than 0.028 inch.

4. **Self Drilling Screws**: Size as indicated.

5. **Side-Lap and Perimeter Edge Fastening**: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span as indicated.

B. **End Bearing**: Install deck ends over supporting frame with a minimum end bearing length as indicated with end joints as follows:

   1. **End Joints**: Lapped as indicated

C. **Miscellaneous Roof-Deck Accessories**: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer’s written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

   1. **Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.**

3.4 **FLOOR-DECK INSTALLATION**

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

   1. **Weld Diameter**: As indicated
   2. **Weld Spacing**: Space and locate welds as indicated.
   3. **Weld Washers**: Install weld washers at each weld location when the minimum uncoated steel thickness is less than 0.028 inch.
   4. **Where welded studs are field applied through deck, such studs may be substituted for a deck connection on a one for one basis.**

B. **Side-Lap and Perimeter Edge Fastening**: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches (910 mm), and as indicated and as follows:

   1. Mechanically fasten with self-drilling, No. 10 (4.8-mm-) diameter or larger, carbon-steel screws.
   2. Mechanically clinch or button punch.
   3. Fasten with a minimum of 1-1/2-inch- (38-mm-) long welds.

C. **End Bearing**: Install deck ends over supporting frame with a minimum end bearing length as indicated, with end joints as follows:

   1. **End Joints**: As indicated

D. **Pour Stops and Girder Fillers**: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

E. **Floor-Deck Closures**: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

F. **Studs shall be field welded to the structural members only after all steel framing, deck are in place and shored when required. Deck shall be installed so that the bottom rib plate is in continuous contact with the surface to receive the studs.**

G. **Stud Shear Connector Capacity**: Number of shear connectors indicated on the drawings is based on the allowable capacity for shear connectors in normal weight or light weight concrete as listed in AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings for the composite
deck specified. If additional shear connectors are required due to decreases in the capacity of shear connectors for the type of deck and stud placement supplied, such additional shear connectors shall be provided at no additional cost to the Owner.

H. Installation:

1. Install shear connectors in accordance with Manufacturer’s instructions. Use only personnel and equipment authorized by the Manufacturer.
2. Use through-deck shear connector welding where deck material thickness permits proper weld fusion to develop required connector capacity. Provide adequate test results to verify the feasibility of through-deck welding for the particular connector sizes and deck thicknesses involved.
3. If through-deck shear connector welding is not feasible, install shear connectors through prepunched holes in the deck. Provide prepunched holes only for the shear connectors involved and keep hole oversize to the minimum required to develop a proper weld.
4. At the beginning of each shift of work, and after each time welding equipment has been moved, two test studs shall be installed and bent to 45 degrees by the Contractor. If failure occurs, adjust equipment and repeat test. Two consecutive test studs shall be welded and found satisfactory before production for that shift begins or is resumed.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. The Testing Agency shall visually inspect all metal deck to observe that the deck is the proper type, depth, finish, is not damaged or rusted, and has been properly installed. Verify the overlapping edges of panels are in close contact at sidelaps.

C. The Testing Agency shall visually inspect all deck welds and fasteners prior to being covered by other work. Verify weld and fastener size, spacing, and quality of attachment. Verify that screw threads are not stripped. Verify that stand-off of powder actuated fasteners are within Manufacturer’s recommendations.

D. Verification of proper size, number and location of stud shear connectors installed directly to steel and through metal deck.

E. Weld testing of shear stud connectors installed through metal deck shall be tested as specified in Division 5 Section, "Structural Steel."

F. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

G. Remove and replace work that does not comply with specified requirements.

H. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.
1. Do not use deck units for storage or as a working platform until permanently secured in position.
2. The General Contractor shall assure that completed deck is not damaged by use as a runaway, storage of materials or subsequent work. He is to assure that construction loads are not allowed which exceed the safe carrying capacity of the deck.

END OF SECTION 053100
SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Roof trusses.
   2. Roof rafter framing.

B. Related Sections include the following:
   1. Division 05 Section "Metal Fabrications" for masonry shelf angles and connections.
   2. Division 09 Section "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
   3. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   a. Design Loads: As indicated.

   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      b. Roof Rafter Framing: Horizontal deflection of 1/240 of the horizontally projected span.

   3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F (67 deg C).

   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. Upward and downward movement of L/200 for roofs.

B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

   1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
   2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
3. Roof Trusses: Design according to AISI's "Standard for Cold-Formed Steel Framing - Truss Design."

1.4 ALTERNATE SIZES

A. In lieu of the cold-formed metal framing sizes shown on the drawings, the Contractor may employ a professional engineer registered in the State of the project to design the complete system using alternate sizes. The Contractor shall design all members and connections not sized or shown.

1.5 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products.

1.6 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.


E. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:

2.2 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. Grade: ST33H (ST230H) 33 ksi for studs 18 gauge and lighter. ST50H (ST340H)
2. Coating: G60 (Z180), or equivalent

2.3 ROOF TRUSSES

1. Roof Truss Members: Manufacturer's standard shape steel sections

2.4 ROOF RAFTER FRAMING

A. Steel Rafters: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: as indicated
2. Flange Width: as indicated.
3. Section Properties: As indicated.

B. Built-up Members: Built-up members of manufacturer's standard C-shaped steel section, with stiffened flanges, nested into a U-shaped steel section joist track, with unstiffened flanges; unpunched; of web depths indicated; and as follows:

1. Minimum Base-Metal Thickness: Matching steel rafters.
2. Flange Width: 1-5/8 inches (41 mm) minimum.

2.5 CEILING JOIST FRAMING

A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, unpunched with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0329 inch (0.84 mm)
2. Flange Width: 1-5/8 inches (41 mm).
3. Section Properties: As required

2.6 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

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

2.7 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

E. Welding Electrodes: Comply with AWS standards.

2.8 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.9 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
   a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

C. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
   a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 JOIST INSTALLATION

A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.

B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.

1. Install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.

C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:

1. Joist Spacing: As indicated.

D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.

E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.

F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:

1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.

G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.

H. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.

3.5 TRUSS INSTALLATION

A. Install, bridge, and brace trusses according to Shop Drawings and requirements in this Section.

B. Truss Spacing: As indicated.

C. Do not alter, cut, or remove framing members or connections of trusses.
D. Erect trusses with plane of truss webs plumb and parallel to each other, align, and accurately position at spacings indicated.

E. Erect trusses without damaging framing members or connections.

F. Anchor trusses securely at all bearing points.

G. Install continuous bridging and permanently brace trusses as indicated on Shop Drawings and designed according to LGSEA's Technical Note 551e, "Design Guide for Permanent Bracing of Cold-Formed Steel Trusses."

3.6 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000
SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Elevator machine beams, hoist beams, and divider beams.
   2. Steel shapes for supporting elevator door sills.
   3. Roof tie-offs, framing.
   4. Shelf angles.
   5. Metal ladder to elevator pit.
   6. Loose bearing and leveling plates for applications where they are not specified in other Sections.
   7. Stair nosings.
   8. Cast iron wheel guards.

B. Products furnished, but not installed, under this Section:
   1. Loose steel lintels.

C. Related Sections:
   1. Division 03 Section "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
   2. Division 04 Section "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
   3. Division 05 Section "Structural Steel Framing."
   4. Division 05 Section "Pipe and Tube Railings."

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Metal non-slip treads.
   2. Paint products.

B. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.

C. Shop Drawings: Show fabrication and installation details for metal fabrications.
1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

D. Samples for Verification: For each type and finish of extruded nosing and tread.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For qualified professional engineer.

G. Welding certificates.

H. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.4 QUALITY ASSURANCE

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

1.5 PROJECT CONDITIONS

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

1.6 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

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

PART 2 - PRODUCTS

2.1 METALS, GENERAL

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

2.2 FERROUS METALS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.3 FASTENERS

A. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

B. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

C. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

D. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).


G. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

H. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

I. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.


2.4 MISCELLANEOUS MATERIALS

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

B. Shop Primers: Provide primers that comply with Division 09 painting Sections.

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Concrete: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form exposed work with accurate angles and surfaces and straight edges.

D. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.

E. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

C. Prime miscellaneous framing and supports primer specified.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.
   1. Provide mitered and welded units at corners.
   2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Prime shelf angles located in exterior walls.

D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.
2.8 METAL LADDERS

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

B. Steel Ladders:
   1. Space siderails of elevator pit ladders 12 inches (300 mm) apart.
   2. Siderails: Continuous, 3/8-by-2-1/2-inch (9.5-by-64-mm) steel flat bars, with eased edges.
   3. Rungs: 3/4-inch- (19-mm-) square steel bars.
   4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
   5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
   6. Support each ladder at top and bottom and not more than 60 inches (1500 mm) o.c. with welded or bolted steel brackets.

2.9 ABRASIVE METAL TREAD INSERTS

A. Extruded Aluminum Units: Extruded aluminum guidance strip, with an integral-abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both. Fabricate units in lengths necessary to accurately fit openings or conditions.

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

      a. Ecoglo (864) 363-0766, Strip EZ071.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Drill for mechanical anchors and countersink. Locate holes not more than 4 inches (100 mm) from ends and not more than 12 inches (300 mm) o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by manufacturer.

   1. Provide two rows of holes for units more than 5 inches (125 mm) wide, with two holes aligned at ends and intermediate holes staggered.

D. Apply bituminous paint to concealed surfaces of cast-metal units.

2.10 CAST-IRON WHEEL GUARDS

A. Provide wheel guards made from cast iron, 3/4 inch (19 mm) thick, hollow-core construction, of size and shape indicated. Provide holes for countersunk anchor bolts and grouting.

B. Prime cast iron wheel guards with zinc-rich primer. Primer specified in Division 09 Section "High-Performance Coatings."
2.11 LOOSE BEARING AND LEVELING PLATES
A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
B. Galvanize plates.
C. Prime plates.

2.12 LOOSE STEEL LINTELS
A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.
B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches (200 mm) unless otherwise indicated.
C. Prime loose steel lintels located in exterior walls.

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

2.14 FINISHES, GENERAL
A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Finish metal fabrications after assembly.
C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.15 STEEL AND IRON FINISHES
A. Shop prime iron and steel items unless they are to be embedded in concrete unless otherwise indicated.
   1. Shop prime with universal shop primer.
B. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING EXTRUDED TREAD INSERTS

A. Center nosings on tread widths unless otherwise indicated.

3.4 INSTALLING BEARING AND LEVELING PLATES


B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, metallic in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

END OF SECTION 055000
SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Steel tube railings.

B. Related Sections:
   1. Division 09 Section "Non-Structural Metal Framing" for metal backing for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated. Refer to CU Standard Handrail detail.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   1. Steel: 72 percent of minimum yield strength.

C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lb/ft. (0.73 kN/m) applied in any direction.
      b. Concentrated load of 200 lb (0.89 kN) applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lb (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
      b. Infill load and other loads need not be assumed to act concurrently.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Manufacturer's product lines of mechanically connected railings.
   2. Railing brackets.

B. LEED Submittals:
   1. Product Data for Credit MR 4.1 and Credit MR 4.2: Indicating percentages by weight of postconsumer and preconsumer recycled content for products having recycled content. Include statement indicating costs for each product having recycled content.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Qualification Data: For qualified professional engineer and testing agency.

F. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

G. Welding certificates.

H. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

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

1.6 PROJECT CONDITIONS

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

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

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

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

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

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.2 STEEL AND IRON

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 Insert number percent.

B. Regional Materials: Provide statement from the manufacturer stating the materials provided were manufactured within a 500 mile location of project. Include location.

C. Tubing: ASTM A 500 (cold formed).

D. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

   1. Provide galvanized finish for exterior installations and where indicated.

E. Plates, Shapes, and Bars: ASTM A 36/A 36M.

F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.3 FASTENERS

A. General: Provide the following:

   1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
   2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

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

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Shop Primers: Provide primers that comply with Division 09 painting Sections.

E. Shop Primer: Fast-curing, lead- and chromate-free, universal tong oil primer compatible with topcoat.
   1. One shop coat of Tnemec 10-99.
   2. Two shop coats of Tnemec 10-99 on ferrous metals that will be inaccessible after erection.

F. Shop Primer for Galvanized Steel: Water based galvanized metal primer complying with MPI#134.

G. Intermediate Coats and Topcoats: Provide products that comply with Division 09 painting Sections.

H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.


2.5 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form changes in direction as follows:
   1. As detailed.

J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. For railing posts set in new concrete, provide stainless-steel sleeves not less than 6 inches (150 mm) long with inside dimensions not less than 1/2 inch (13 mm) greater than outside dimensions of post, with metal plate forming bottom closure.

P. For railing posts set in existing concrete. Core drill concrete to create sleeve.

2.6 FINISHES, GENERAL

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

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

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.7 STEEL AND IRON FINISHES

A. Galvanized Railings:
   1. Hot-dip galvanize exterior steel and iron railings, including hardware, after fabrication.
   2. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
   3. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning." SSPC-SP 3, "Power Tool Cleaning." requirements indicated below:
   2. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
   1. Shop prime railings indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
   1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
   2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

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

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

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

3.2 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches (50 mm) beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches (150 mm) of post.

3.3 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 3 inches deep (or CU Standard) and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post anchoring material flush with adjacent surface.

3.4 Attaching Railings (Refer to CU Standard Handrail Detail)

A. Attach railings to wall with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.

2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges to building construction as follows:
1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For steel-framed partitions, use hanger or lag bolts set into fire retarded wood backing between studs. Coordinate with stud installation to locate backing members.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

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

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
SECTION 071113 - BITUMINOUS DAMPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Cold-applied, cut-back asphalt damproothing.

B. Related Sections include the following:
   1. Division 07 Section "Cold Fluid-Applied Waterproofing" for waterproofing.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

B. Material Certificates: For each product, signed by manufacturers.

C. LEED Submittal:
   1. Product Data for Credit EQ 4.2: For damproothing, including printed statement of VOC content.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain primary damproothing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit damproothing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of damproothing in enclosed spaces. Maintain ventilation until damproothing has cured.
PART 2 - PRODUCTS

2.1 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

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

1. ChemMasters Corp.
2. Degussa Building Systems; Sonneborn Brand Products.
3. Gardner Gibson, Inc.
6. Koppers Inc.
7. Malarkey Roofing Products.

B. Trowel Coats: ASTM D 4586, Type I, Class I, fibered.

C. Brush and Spray Coats: ASTM D 4479, Type I, fibered or nonfibered.

D. VOC Content: 250 g/L or less.

2.2 PROTECTION COURSE

A. Protection Course: Fan folded, with a core of extruded-polystyrene board insulation faced on both side(s) with plastic film, nominal thickness 1/4 inch (6 mm), with compressive strength of not less than 8 psi (55 kPa) per ASTM D 1621, and maximum water absorption by volume of 0.6 percent per ASTM C 272.

2.3 MISCELLANEOUS MATERIALS


B. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

C. Patching Compound: Manufacturer's fibered mastic of type recommended by dampproofing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.

1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
2. Test for surface moisture according to ASTM D 4263.
3.2 PREPARATION

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.

1. Apply additional coats if recommended by manufacturer or if required to achieve coverages indicated.
2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats.
3. Allow 48 hours drying time prior to backfilling.

B. Apply dampproofing to footings and foundation walls where opposite side of wall faces building interior.

1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches (150 mm) over outside face of footing.
2. Extend 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

A. On Concrete Foundations: Apply 2 brush or spray coats at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, or 1 trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

B. On Unexposed Face of Concrete Retaining Walls: Apply 1 brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

C. On Unexposed Face of Masonry Retaining Walls: Apply primer and 1 brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

3.5 INSTALLATION OF PROTECTION COURSE

A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing material manufacturer's written recommendations for attaching protection course.

1. Support protection course with spot application of adhesive of type recommended by protection board manufacturer over cured coating.
2. Install protection course on same day of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.6 CLEANING

A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION 071113
SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

B. Related Section:
   1. Division 04 Section “Unit Masonry” for waterproof masonry walls.
   2. Division 07 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.

B. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
   1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.

C. Samples: For the following products:
   1. Flashing sheet, 10 by 8 inches (250 by 200 mm).

D. Qualification Data: For Installer.

E. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.

F. Field quality-control reports.

G. Warranty: Sample of special warranty.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A firm that is approved or licensed by waterproofing manufacturer for installation of waterproofing required for this Project.
B. Source Limitations: Obtain waterproofing materials.

C. Preinstallation Conference: Conduct conference at Project site.
   1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F (3 deg C) above dew point.
   1. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.7 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which waterproofing manufacturer and Installer agree to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
   1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/16 inch (1.6 mm) in width.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

A. Single-Component, Modified Polyurethane Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Permaquik Inc.; PQ 6800.
   c. Carlisle Coatings & Waterproofing Inc.; CCW-525.
   d. CETCO; LDC 60.
   e. Degussa Building Systems; HLM 5000.
   f. Karnak Corporation; One-Kote System.
   g. Meadows, W.R., Inc.; Sealight Meadow-Pruf Seamless
   h. Mer-Kote Products, Inc.; Mer-Than 320.
   i. Neogard, Div. of Jones-Blair; Neogard 7401.
   k. Tremco Incorporated; Tremproof 60.
   l. United Coatings; Elastall 1000.

2.2 AUXILIARY MATERIALS

   A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.

   B. Primer: Manufacturer's standard, factory-formulated polyurethane or epoxy primer.

   C. Sheet Flashing: 50-mil- (1.3-mm-) minimum, nonstaining, uncured sheet neoprene.
      1. Adhesive: Manufacturer's recommended contact adhesive.

   D. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

   E. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing, complying with ASTM C 920 Type M, Class 25; Grade NS for sloping and vertical applications or Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.
      1. Backer Rod: Closed-cell polyethylene foam.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
      1. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
      2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

   A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for waterproofing application.
B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage or overspray affecting other construction.

3.3 PREPARATION AT TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C 898 and manufacturer's written instructions.

B. Prime substrate unless otherwise instructed by waterproofing manufacturer.

C. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 898 and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.

2. Apply bond breaker between sealant and preparation strip.
3. Prime substrate and apply a single thickness of preparation strip extending a minimum of 3 inches (75 mm) along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

B. Install sheet flashing and bond to wall substrates where indicated or required according to waterproofing manufacturer's written instructions.

1. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate according to ASTM C 898.

3.5 WATERPROOFING APPLICATION

A. Apply waterproofing according to ASTM C 898 and manufacturer's written instructions.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils (1.5 mm) and a minimum dry film thickness of 50 mils (1.3 mm) at any point.
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify wet film thickness of waterproofing every 100 sq. ft. (9.3 sq. m).
3.6 FIELD QUALITY CONTROL

A. Owner will engage an independent testing agency to observe testing and examine walls and terminations for evidence of leaks during flood testing.

3.7 CURING, PROTECTION, AND CLEANING

A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 071416
SECTION 072100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Glass-fiber blanket insulation.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. LEED Submittals:
      1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
   C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.4 QUALITY ASSURANCE
   A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      1. Flame spread rating: not more than 25.
      2. Smoke rating: not more than 50.
   B. Insulation R Values:
      1. Roof: R30.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
      1. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET INSULATION

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

1. CertainTeed Corporation.
2. Guardian Building Products, Inc.
5. Owens Corning.

B. Attic Roof Insulation:

1. Reinforced-Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category I (membrane is a vapor barrier), faced with foil scrim, foil faced vapor barrier.

C. Exposed under roof insulation.

1. White Polypropylene-Scrim-Kraft-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type II (non-reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category I (membrane is a vapor barrier).

   a. Lamotite or approved equal.

D. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:

1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

E. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches (38 mm) square or in diameter.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. AGM Industries, Inc.; RC150, SC150.
   b. Gemco; Dome-Cap R-150, S-150.

2. Product ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in the following locations:

   a. Roof spaces.
   b. Attic spaces.
2.2 INSULATION FASTENERS

A. Screw Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   
   a. AGM Industries, Inc.; Series T TACTOO Insul-Hangers.
   b. Gemco; Spindle Type.

2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.

3. Spindle: Copper-coated, low-carbon steel; fully annealed; 0.105 inch (2.67 mm) in diameter; length to suit depth of insulation indicated, ¼” penetration into wood deck.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Glass-Fiber or Mineral-Wool Blanket Insulation: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

5. With faced blankets having stapling flanges, lap blanket flange over flange of adjacent blanket to maintain continuity of vapor retarder once finish material is installed over it.

6. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

   a. Exterior Walls: Set units with facing placed toward interior of construction.

7. Under attic roof insulation:

   a. Pin spacing shall conform to the manufacturer’s recommendations and be adequate to keep the insulation from sagging (typically, not more than 24 inches). The spacing shall follow a uniform pattern to achieve an even appearance. All again approximately ½” and stapling them together (using a paper stapler), with staple spacing not exceeding 3”. This is known as stapled hem stitching. Joints that cannot be stapled shall be sealed with a tape that is compatible with the vapor-barrier, both in appearance and adhesion, and does not degrade the rating of the assembly. The washers shall also be taped over, or be sealed with brush-on insulation sealer, such as used on piping insulation.

   b. Fire sprinklers or their sprinkling system shall not be affected by the insulation.

8. Exposed under roof insulation:

   a. Pin spacing shall conform to the manufacturer’s recommendation and be adequate to keep the insulation from sagging (typically, not more than 24 inches). The spacing shall have a uniform pattern to achieve an even appearance. All joints shall be sealed with a tape which is compatible with the vapor-barrier, both in appearance and adhesivity, and does not degrade the rating of the assembly. The washers shall also be covered with the tape.

   b. Fire sprinklers or their sprinkling system shall not be affected by the insulation.

C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass Fiber Blanket Insulation.

3.4 PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100
SECTION 073213 - CLAY ROOF TILES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   2. Underlayment.
   3. Snow guards.

B. Related Sections:
   1. Division 06 Section "Sheathing" for roof sheathing.

1.3 DEFINITIONS


1.4 SUBMITTALS

A. Product Data: Submit specifications and installation instructions from the manufacturer for roofing system required. Include data substantiating compliance with the requirements.

B. LEED Submittals:
   1. Product Test Reports for Credit SS 7.2: For clay roof tiles, documentation indicating compliance with Solar Reflectance Index requirement.

C. Samples for Verification: For the following products, in manufacturer's standard sizes:
   2. Accessory Tile: Full size, each type.
   3. Fastenings: Wire-tie system components, 12 inches (305 mm) long.

D. Material Test Reports: For each type of clay roof tile.

E. Research/Evaluation Reports: For clay roof tiles, fasteners, and fastener systems, from the ICC.

F. Maintenance Data: For roofing to include in maintenance manuals.

G. Warranties: Sample of special warranties.
1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain clay roof tiles and accessory tiles from single source from single manufacturer.

B. Fire-Test-Response Characteristics: Provide clay roof tiles and related roofing materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; UL 790 or ASTM E 108, for application and roof slopes indicated.

C. Manufacturer Qualifications: Furnish products manufactured by a firm having not less than 5 years successful experience in the production of the type of roofing tiles required.

D. Installer Qualifications:

1. Installer: Company specializing in tile roofs with five years continuous experience.
2. Pre-Bid Approval shall be obtained from the Owner prior to bidding tile roof installation.
3. Submit a minimum of two similar jobs successfully completed within the last four years.

E. Conform to details and installation requirements of NRCA Roofing & Waterproofing Manual, Steep Roofing, Tile Roofing sections except as otherwise indicated.

F. All installation procedures must be approved by the Owner prior to commencing work.

G. Mock-up:

1. Prior to ordering tile, install a 4’ x 8’ mock-up at ground level at location directed by Architect for verification, showing full range of color, color distribution and trim pieces. Modify blends and colors as required. Order tile based on approved mock-up.
2. Install 16’ x 16’ mock-up in-place on roof structure, showing full range of color, color distribution and trim pieces. Obtain Architect’s acceptance before proceeding with remainder of roof installation and revise mock-up until accepted. All or part of mock-up which is acceptable may be retained as part of permanent installation.
3. Approval of mock-ups doesn’t constitute approval of deviations from the Contract Documents contained in mock-up unless Architect specifically approves such deviations in writing.

H. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store underlayment rolls on end, on pallets or other raised surfaces. Do not double stack rolls.

1. Handle, store, and place roofing materials in a manner to avoid significant or permanent damage to roof deck or structural supporting members.

B. Protect unused underlayment from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.
1.7 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing to be performed according to manufacturer's written instructions and warranty requirements.

1. Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended by manufacturer.

B. Proceed with roofing work only after substrate construction and penetration work have been completed.

1.8 WARRANTY

A. Special Warranty: Standard form in which manufacturer agrees to repair or replace clay roof tiles that fail in materials within specified warranty period.

1. Materials-Only Warranty Period: 50 years from date of Substantial Completion.

B. Special Project Warranty: Roofing Installer's Warranty, on warranty form at end of this Section, signed by roofing Installer, covering Work of this Section, in which roofing Installer agrees to repair or replace components of roofing that fail in materials or workmanship within the following warranty period:

1. Warranty Period: Five years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Clay Roof Tiles: Provide 2% extra stock, in new condition, for each color, texture and shape of tile installed.

PART 2 - PRODUCTS

2.1 CLAY ROOF TILES

A. Clay Roof Tiles: ASTM C 1167, molded- or extruded-clay roof tile units of shape and configuration indicated, kiln fired to vitrification, and free of surface imperfections. Provide with fastening holes prepunched at factory before firing.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Ludowici Roof Tile. Fired vitrified clay roofing tile, ASTM C56, manufacturer's standard unglazed units, as manufactured by Ludowici Celadon.

2. Furnish French Tile design units with matching ridge, edge, eave and other fittings, 14 ¼" length starters with (2) two holes.

a. New construction: 16" length tile.

3. Tile at hips, ridges, starter course and where wind uplift is a problem shall be 18" tile with (2) two holes. Caulk all exposed nail heads with roof tile caulking or polyurethane caulking.

4. Provide eave and end enclosures for all open tile ends at hips, ridges and eaves. Provide rake tile accessories at roof rakes.

5. Finish and Texture: Match existing.
6. **Color**: As follows:
   a. **Pans**:
      1) Red Range 100%
   b. **Covers**:
      1) Red Range 60%
      2) Burgundy 15%
      3) Red 18%
      4) **Black Slip** 7%
      Total Covers 100%

2.2 **ACCESSORIES**

A. **Asphalt Roofing Cement**: ASTM D 4586, Type II, asbestos free.

B. **Butyl Sealant**: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied.

C. **Elastomeric Sealant**: ASTM C 920, elastomeric polyurethane-based joint sealant; Type S, Grade NS, Class 25. Use NT related to exposure, and, as applicable to joint substrates indicated, Use O.

D. **Roofing Asphalt**: ASTM D 312, Type IV.

E. **Snow Guards**:
   1. Stainless steel. Install snow guards over all entryways – refer to Drawings for locations.

F. **Mortar**: ASTM C 270, Type M, natural color with ASTM C 979, pigmented mortar matching the color of clay roof tiles for exposed-to-view mortar, and natural color for concealed-from-view mortar.

2.3 **FASTENERS**

A. **Roofing Nails**: ASTM F 1667, copper, 0.135-inch- (3.4-mm-) diameter shank, sharp-pointed, conventional roofing nails with barbed shanks; minimum 3/8-inch- (10-mm-) diameter head; of sufficient length to penetrate 3/4 inch (19 mm) into roof-deck sheathing.
   1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

B. **Underlayment Nails**: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch (25-mm) minimum diameter.

2.4 **UNDERLAYMENT MATERIALS**

A. **Self-Adhering Sheet Underlayment, Polyethylene Faced**: ASTM D 1970, a minimum of 40-mil- (1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release paper backing; cold applied. Provide primer for adjoining concrete or masonry surfaces to receive underlayment.
   1. **Manufacturers**: Subject to compliance with requirements, provide products by one of the following:
      a. Carlisle Coatings & Waterproofing, Inc.
      c. Henry Company.
      d. Johns Manville.
2.5 METAL FLASHING AND TRIM

A. General: Comply with requirements in Division 07 Section “Sheet Metal Flashing and Trim.”

1. Sheet Metal: Copper.

B. Fabricate sheet metal flashing and trim to comply with recommendations that apply to design, dimensions, metal, and other characteristics of the item in SMACNA’s “Architectural Sheet Metal Manual.”

1. Apron Flashings: Fabricate with lower flange extending a minimum of 4 inches (100 mm) over and 4 inches (100 mm) beyond each side of downslope tile roofing and 6 inches (152 mm) up the vertical surface.
2. Step Flashings: Fabricate with a head lap of 3 inches (75 mm) and a minimum extension of 4 inches (100 mm) both horizontally and vertically.
3. Channel Flashings: Fabricate with vertical surface extending a minimum of 4 inches (100 mm) above the clay roof tile and 4 inches (100 mm) beneath the tile roofing, with a 1-inch- (25-mm-) high vertical return to form a runoff channel.
4. Rake Pan Flashings: Fabricate with vertical surface extending over fasciae and 6 inches (152 mm) beneath the tile roofing, with a 1-inch- (25-mm-) high vertical return to form a runoff channel.
5. Cricket Backer Flashings: Fabricate with concealed flange extending a minimum of 18 inches (455 mm) beneath upslope tile roofing, 6 inches (152 mm) beyond each side of opening, and 6 inches (152 mm) above the roof plane.
6. Closed-Valley Flashings: Fabricate in lengths not exceeding 10 feet (3 m), with 1-inch- (25-mm-) high, inverted-V profile at center of valley and with equal flange widths of 10 inches (255 mm).
7. Drip Edges: Fabricate in lengths not exceeding 10 feet (3 m), with 2-inch (50-mm) roof-deck flange and 1-1/2-inch (38-mm) fascia flange with 3/8-inch (10-mm) drip at lower edge.

C. Sheet Metal Ridge Vent: Fabricate from 16-oz./sq. ft.- (0.55-mm-) thick copper sheet, terminating each side in V-shaped external baffles with venting holes producing net-free ventilating area of 2.65 sq. in./ft. (56 sq. cm/m).

D. Vent-Pipe Flashings: ASTM B 749, Type L51121, at least 1/16 inch (1.6 mm) thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof and extending at least 4 inches (100 mm) from pipe onto roof.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored and that provision has been made for flashings and penetrations through roofing.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 UNDERLAYMENT INSTALLATION

A. General: Comply with clay roof tile manufacturer's written instructions and recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

1. Cover wood nailers with underlayment strips.

B. Self-Adhering Sheet Underlayment: Install wrinkle free; comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install at locations indicated below, on Drawings, lapped in direction to shed water. Lap sides not less than 3-1/2 inches (89 mm). Lap ends not less than 6 inches (152 mm), staggered 24 inches (610 mm) between succeeding courses. Roll laps with roller. Cover underlayment within seven days.

1. Prime concrete and masonry surfaces to receive self-adhering sheet underlayment.
2. Extend self-adhering sheet underlayment over entire roof deck.

C. Metal-Flushed, Open-Valley Underlayment: Install two layers of 36-inch- (914-mm-) wide underlayment centered in valley. Stagger end laps between layers at least 72 inches (1830 mm). Lap ends of each layer at least 12 inches (305 mm) in direction to shed water, and seal with asphalt roofing cement. Fasten each layer to roof deck with felt underlayment nails.

1. Lap roof-deck underlayment over first layer of valley underlayment at least 6 inches (152 mm).

3.3 METAL FLASHING INSTALLATION

A. General: Install metal flashings and other sheet metal to comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim."

1. Install metal flashings according to clay roof tile manufacturer's written instructions and recommendations in NRCA's "The NRCA Roofing and Waterproofing Manual."

B. Apron Flashings: Extend lower flange over and beyond each side of downslope tile roofing and up the vertical surface.

C. Step Flashings: Install with a head lap of 3 inches (75 mm) and extend both horizontally and vertically. Install with lower edge of flashing just upslope of, and concealed by, butt of overlying tile. Fasten to roof deck only.

D. Open-Valley Flashings: Install centrally in valleys, lapping ends at least 8 inches (205 mm) in direction to shed water. Fasten upper end of each length to roof deck beneath overlap.

1. Adhere 9-inch- (230-mm-) wide strips of self-adhering sheet to metal flanges and to self-adhering sheet underlayment.

E. Channel Flashings: Install over underlayment and fasten to roof deck.

F. Rake Pan Flashings: Install over underlayment and fasten to roof deck.

G. Rake Drip Edges: Install over underlayment and fasten to roof deck.

H. Eave Drip Edges: Install beneath underlayment and fasten to roof deck.

I. Pipe Flashings: Form flashing around pipe penetrations and tile roofing. Fasten and seal to tile roofing.
3.4 CLAY ROOF TILE INSTALLATION

A. Installation of Roofing Tile:
   1. Except as otherwise indicated, install tiles to match Owner’s existing roofs, accepted mock-up, and as recommended by the manufacturer.
   2. Take special care in handling and working over installed tile to avoid cracking, chipping or breaking of the tiles. Replace any broken or chipped tile found during installation.
   3. Provide accessory items as shown and as required to make a complete installation of roofing, including flashing integrated with the tile work.

B. Secure with nails with side and head lap as recommended by manufacturer for required exposure, climate, wind and conditions, and roof slope. Include closers, ridge, edge and hip units as indicated or required. Caulk all nail heads by setting them in roof tile sealant. Ensure nails penetrate wood (batten) substrate 3/8” minimum.

C. Provide bird stops at all open tile ends to match existing roofs.

D. Seal rakes and ridges to field tile with polyurethane or roof tile sealant.

E. Install roof tile using “tight” method.

F. Install at least 3 or more staggered rows, as size of roof requires, of snow guards at all sloped roofs where indicated on the roof plan.

G. All tile shall be nailed including pan and cover tile. No exceptions.

H. Valleys shall have 6” wide opening to allow water to drain. Concrete mortar will be used to cover end of cut tile in valley.

I. Tile shall be installed to withstand 100 mph winds.

J. All curbs heights shall be 12” above finished roof.

K. Install permanent tie-off anchors on all new roofs for access to all areas of tile roofs.

3.5 SNOW-GUARD INSTALLATION

A. Snow-Guard Pads: Install snow-guard pads at locations indicated on Drawings.

3.6 TIE-OFF ANCHORS

A. Install permanent tie-off anchors for access to all areas of tile roof.

3.7 ADJUSTING AND CLEANING

A. Remove and replace damaged or broken clay roof tiles.

B. Remove excess clay roof tiles and debris from Project site.
3.8 ROOFING INSTALLER’S WARRANTY

A. WHEREAS Insert name of Insert address, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: Insert name of Owner.
2. Address: Insert address.
3. Building Name/Type: Insert information.
4. Address: Insert address.
5. Area of Work: Insert information.
6. Acceptance Date: Insert date.
7. Warranty Period: Insert time.
8. Expiration Date: Insert date.

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
   a. Lightning;
   b. Peak gust wind speed exceeding 100 mph (m/sec);
   c. Fire;
   d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. Vapor condensation on bottom of roofing; and
   g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of the foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use
or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS WHEREOF, this instrument has been duly executed this Insert day day of Insert month, Insert year.

1. Authorized Signature: Insert signature.
2. Name: Insert name.
3. Title: Insert title.

END OF SECTION 073213
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed Products:
   a. Formed roof drainage sheet metal fabrications.
   b. Formed steep-slope roof sheet metal fabrications.
   c. Formed wall sheet metal fabrications.

B. Related Sections:

1. and blocking.
2. Division 07 Section "Tile Roof Panels" for installing sheet metal flashing and trim integral with roofing.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Fabricate and install roof edge flashing and copings capable of resisting the following forces according to recommendations in FMG Loss Prevention Data Sheet 1-49: Wind speeds of 100 MPH.

C. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.
9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches (1:10).

C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches (300 mm) long and in required profile. Include fasteners and other exposed accessories.
3. Accessories and Miscellaneous Materials: Full-size Sample.

E. Qualification Data: For qualified fabricator.

F. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

G. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA’s "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

C. Copper Sheet Metal Standard: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof eave, including gutter, apron flashing, approximately 10 feet (3.0 m) long, including supporting construction cleats, seams, attachments, underlayment, and accessories.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

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

B. Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 or H01 temper.

  1. Non-Patinated Exposed Finish: Mill.

2.2 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

  2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).
  3. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
c. Henry Company: Blueskin PE200 HT.
d. Metal-Fab Manufacturing, LLC; MetShield.
e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

C. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   b. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Copper Sheet: Copper, hardware bronze or Series 300 stainless steel.

C. Solder:

1. For Copper: ASTM B 32, Grade Sn50, 50 percent tin and 50 percent lead.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.


2.4 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions, with interlocking counterflashing on exterior face, of same metal as reglet.

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

   a. Cheney Flashing Company.
   b. Fry Reglet Corporation.
   c. Heckmann Building Products Inc.
   d. Hickman, W. P. Company.
   e. Hohmann & Barnard, Inc.; STF Sawtooth Flashing.
   g. National Sheet Metal Systems, Inc.
   h. Sandell Manufacturing Company, Inc.
2. Material: Copper, 16 oz./sq. ft. (0.55 mm thick).
3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
4. Accessories:
   a. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
5. Finish: Mill.

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA’s "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

C. Sealed Joints: No sealed joints.

D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by SMACNA’s "Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- (2400-mm-) long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters, of size recommended by SMACNA but not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
1. Refer to CU Standard Gutter detail.
2. Expansion Joints: Lap type, no more than 15 feet o.c.
3. Gutters with Girth up to 15 inches (380 mm): Fabricate from the following materials:
   a. Copper: 16 oz./sq. ft. (0.55 mm thick).
4. Gutters with Girth 16 to 20 inches (410 to 510 mm): Fabricate from the following materials:
   a. Copper: 16 oz./sq. ft. (0.55 mm thick).
5. Gutters with Girth 21 to 25 inches (530 to 640 mm): Fabricate from the following materials:
   a. Copper: 20 oz./sq. ft. (0.68 mm thick).

B. Downspouts: Fabricate downspouts to matching existing, complete with mitered elbows. Furnish with metal hangers, from same material as downspouts, and anchors.
   1. Hanger Style: Match existing.
   2. Fabricate from the following materials:
      a. Copper: 16 oz./sq. ft. (0.55 mm thick).

C. Splash Pans on Roof Surfaces: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).

2.7 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).

B. Valley Flashing: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).

C. Drip Edges: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).

D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).

E. Counterflashing: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).

F. Flashing Receivers: Fabricate from the following materials:
   1. Copper: 16 oz./sq. ft. (0.55 mm thick).

G. Roof-Penetration Flashing: Fabricate from the following materials:
1. Copper: 16 oz./sq. ft. (0.55 mm thick).

2.8 WALL SHEET METAL FABRICATIONS

A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).

B. Wall Expansion-Joint Cover: Fabricate from the following materials:

1. Copper: 16 oz./sq. ft. (0.55 mm thick).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.
7. Do not use graphite pencils to mark metal surfaces.

B. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.

C. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws metal decking not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

D. Seal joints.
   1. No sealed joints.

E. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed work.
   1. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
   2. Copper Soldering: Tin edges of uncoated copper sheets using solder for copper.

3.4 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or with lapped joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia firmly to match existing gutter installation. Provide end closures and seal watertight with sealant. Slope to downspouts.
   1. Fasten gutter spacers to front and back of gutter, matching existing gutter.
   2. Anchor.
   3. Install gutter with expansion joints at locations indicated, but not exceeding, 40 feet apart. Install expansion-joint caps.

C. Downspouts: Join sections with 1-1/2-inch (38-mm) telescoping joints.
   1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches (1500 mm) o.c. in between.
   2. Provide elbows at base of downspout to direct water away from building.
      a. Refer to CU Standard for downspout termination.
D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints a minimum of 4 inches (100 mm) in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA’s "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at 16-inch (400-mm) centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
   1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch (400-mm) centers.
   2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch (600-mm) centers.

D. Copings: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
   1. Anchor interior leg of coping with screw fasteners and washers at 20-inch (500-mm) centers.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with sealant. Secure in a waterproof manner by means of snap-in installation and sealant or lead wedges and sealant.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Reglets: Installation of reglets is specified in Division 04 Section "Unit Masonry."

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA’s "Guide Specification for Residential Metal Roofing."
3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.

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

END OF SECTION 076200
SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes joint sealants for the applications indicated in the Joint-Sealant Schedule at the end of Part 3, following applications, including those specified by reference to this Section: following applications:

1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   b. Joints between plant-precast architectural concrete units.
   c. Control and expansion joints in unit masonry.
   d. Joints in sheet metal flashing.
   e. Joints between different materials listed above.
   f. Perimeter joints between materials listed above and frames of doors, windows and louvers.
   g. Control and expansion joints in ceilings and other overhead surfaces.
   h. Other required joints.

2. Exterior joints in the following horizontal traffic surfaces:
   a. Isolation and contraction joints in cast-in-place concrete slabs.
   b. Tile control and expansion joints.
   c. Joints between different materials listed above.
   d. Joints in concrete topping.
   e. Other required joints.

3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings.
   c. Tile control and expansion joints.
   d. Vertical joints on exposed surfaces of concrete, walls and partitions.
   e. Perimeter joints between interior wall surfaces and frames of interior doors.
   f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   g. Other required joints.

4. Interior joints in the following horizontal traffic surfaces:
   a. Control and expansion joints in concrete topping.
   b. Control and expansion joints in tile flooring.
   c. Other joints as indicated.

B. Related Sections include the following:
   1. Division 4 Section "Unit Masonry Assemblies" for masonry control and expansion joint fillers and gaskets.
2. Division 7 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
3. Division 8 Section "Glazing" for glazing sealants.
4. Division 9 Section "Gypsum Board Assemblies" for sealing perimeter joints of gypsum board partitions to reduce sound transmission.
5. Division 9 Section "Ceramic Tile" for sealing tile joints.
6. Division 9 Section "Acoustical Panel Ceilings" for sealing edge moldings at perimeters of acoustical ceilings.

1.3 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

E. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

F. Qualification Data: For Installer.

G. Preconstruction Field Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on preconstruction testing specified in "Quality Assurance" Article.

H. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

I. Field Test Report Log: For each elastomeric sealant application.

J. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

K. Warranties: Special warranties specified in this Section.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
   1. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the Notice to Proceed with the Work.
   1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
   2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
   3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
   4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

D. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
   1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (5 deg C).
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.
B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

D. Multicomponent Nonsag Polysulfide Sealant:

1. Available Products:
   a. Pacific Polymers, Inc.; Elasto-Seal 227 Type II (Gun Grade).
   b. Pecora Corporation; Synthacalk GC-2+.
   d. PolySpec Corp.; T-2235-M.
   e. PolySpec Corp.; T-2282.
f. PolySpec Corp.; Thiokol 2P.
g. Sonneborn, Division of ChemRex Inc.; Sonolastic Polysulfide Sealant.

2. Type and Grade: M (multicomponent) and NS (nonsag).
4. Uses Related to Exposure: T (traffic), NT (nontraffic), T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

E. Multicomponent Pourable Polysulfide Sealant:

1. Available Products:
   b. Pacific Polymers, Inc.; Elastoseal 227 Type I (Pourable).

2. Type and Grade: M (multicomponent) and P (pourable).
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: Brick, ceramic tile, wood and other Use O substrates.

F. Multicomponent Nonsag Neutral-Curing Silicone Sealant:

1. Available Products:
   a. Dow Corning Corporation; 756 H.P.

2. Type and Grade: M (multicomponent) and P (pourable).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

G. Multicomponent Pourable Neutral-Curing Silicone Sealant:

1. Available Products:
   a. Dow Corning Corporation; FC Parking Structure Sealant.

2. Type and Grade: M (multicomponent) and P (pourable).
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

H. Single-Component Pourable Neutral-Curing Silicone Sealant:

1. Available Products:
   a. Dow Corning Corporation; 890-SL.
b. Pecora Corporation; 300 Pavement Sealant (Self Leveling).
c. Dow Corning Corporation; SL Parking Structure Sealant.

2. Type and Grade: S (single component) and P (pourable).
3. Class: 100/50.
4. Uses Related to Exposure: NT and T (traffic).
5. Uses Related to Joint Substrates: M, A and O, as applicable to joint substrates indicated.

   a. Use O Joint Substrates: Galvanized steel, brick, ceramic tile and other Use O substrates.

I. Single-Component Neutral- and Basic-Curing Silicone Sealant:

1. Available Products:

   a. Dow Corning Corporation; 790.
   b. GE Silicones; SilPruf LM SCS2700.
   c. Tremco; Spectrem 1 (Basic).

2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50, 100/50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.


J. Single-Component Neutral-Curing Silicone Sealant:

1. Available Products:

   a. Dow Corning Corporation; 799.
   b. GE Silicones; UltraGlaze SSG4000.
   c. GE Silicones; UltraGlaze SSG4000AC.
   f. Tremco; Proglaze SG.
   g. Tremco; Spectrem 2.
   h. Tremco; Tremsil 600.

2. Type and Grade: S (single component) and NS (nonsag).
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.


K. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:

1. Available Products:

   a. Pecora Corporation; 898.
b. Tremco; Tremsil 600 White.

2. Type and Grade: S (single component) and NS (nonsag).
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.


L. Multicomponent Nonsag Urethane Sealant:

1. Available Products:
   a. Pecora Corporation; Dynatrol II.
   b. Tremco; Dymeric 511.
   c. Tremco; Vulkem 922.
   d. Insert manufacturer's name; product.

2. Type and Grade: M (multicomponent) and NS (nonsag).
3. Class: 50.
4. Uses Related to Exposure: NT (nontraffic) and T (traffic).
5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.


M. Multicomponent Pourable Urethane Sealant:

1. Available Products:
   b. Meadows, W. R., Inc.; POURTHANE.
   c. Pacific Polymers, Inc.; Elasto-Than 227 High Shore Type I (Self Leveling).
   d. Pacific Polymers, Inc.; Elasto-Than 227 Type I (Self Leveling).
   e. Pecora Corporation; Urethane NR-200.
   f. Polymeric Systems Inc.; PSI-270SL.
   g. Schnee-Morehead, Inc.; Permthane SM 7201.
   h. Tremco; THC-901.
   i. Tremco; THC-900.
   j. Tremco; Vulkem 245.

2. Type and Grade: M (multicomponent) and P (pourable).
4. Use Related to Exposure: T (traffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

2.4 LATEX JOINT SEALANTS

A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

B. Available Products:
1. Bostik Findley; Chem-Calk 600.
4. Sonneborn, Division of ChemRex Inc.; Sonolac.
5. Tremco; Tremflex 834.

2.5 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints AS-#: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
2. Available Products:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.

2.6 PREFORMED TAPE SEALANTS

A. Back-Bedding Mastic Tape Sealant: Preformed, butyl-based elastomeric tape sealant with a solids content of 100 percent; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Tape Sealant: Closed-cell, PVC foam tape sealant; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:

1. Type 1, for applications in which tape acts as the primary sealant.
2. Type 2, for applications in which tape is used in combination with a full bead of liquid sealant.

2.7 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) O (open-cell material) B (biscellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F (minus 32 deg C). Provide products with low compression set and of size and shape to
provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.
   c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.
   c. Porcelain enamel.
   d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.

a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

H. Installation of Preformed Tapes: Install according to manufacturer's written instructions.

I. Installation of Preformed Silicone-Sealant System: Comply with the following requirements:

1. Apply masking tape to each side of joint, outside of area to be covered by sealant system.
2. Apply silicone sealant to each side of joint to produce a bead of size complying with preformed silicone-sealant system manufacturer's written instructions and covering a bonding area of not less than 3/8 inch (10 mm). Hold edge of sealant bead 1/4 inch (6 mm) inside masking tape.
3. Within 10 minutes of sealant application, press silicone extrusion into sealant to wet extrusion and substrate. Use a roller to apply consistent pressure and ensure uniform contact between sealant and both extrusion and substrate.
4. Complete installation of sealant system in horizontal joints before installing in vertical joints. Lap vertical joints over horizontal joints. At ends of joints, cut silicone extrusion with a razor knife.

J. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:
   a. Perform 10 Insert number tests for the first 1000 feet (300 m) Insert dimension of joint length for each type of elastomeric sealant and joint substrate.
   b. Perform 1 test for each 1000 feet (300 m) Insert dimension of joint length thereafter or 1 test per each floor per elevation.

   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; do this by extending cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.
4. Inspect tested joints and report on the following:
a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

b. Whether sealants filled joint cavities and are free of voids.

c. Whether sealant dimensions and configurations comply with specified requirements.

5. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

6. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE


2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.


1. Joint Sealant: Multicomponent pourable urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

C. Joint-Sealant Application: Exterior vertical control and expansion joints in unit masonry.

2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.
D. Joint-Sealant Application: Exterior vertical joints between different materials listed above.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

E. Joint-Sealant Application: Exterior perimeter joints between masonry and frames of doors windows and louvers.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

F. Joint-Sealant Application: Exterior control and expansion joints in ceilings and other overhead surfaces.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

G. Joint-Sealant Application: Exterior and interior control and expansion joints in horizontal traffic surfaces of concrete topping.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

H. Joint-Sealant Application: Interior perimeter joints of exterior openings.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

I. Joint-Sealant Application: Interior ceramic tile expansion, control, contraction, and isolation joints in horizontal traffic surfaces.
   1. Joint Sealant: Multicomponent pourable polysulfide sealant unless otherwise noted.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

J. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

K. Joint-Sealant Application: Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
   2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

L. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.

END OF SECTION 079200
SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard hollow metal doors and frames.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
2. Division 08 Section "Door Hardware" "Door Hardware (Scheduled by Describing Products)" for door hardware for hollow metal doors.
3. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.
4. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, temperature-rise ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

E. LEED MRc5: Regional Material
   1. Provide a statement from the manufacturer stating that the materials provided were manufactured within a 500 mile radius of the project. Include location.

F. LEED MRc4: Recycled Content
   1. Provide a statement from the manufacturers including recycled content percentage, by weight, and whether the recycled content is post-industrial or post-consumer.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252, UBC Standard 7-2 or UL 10C.
   1. Temperature-Rise Limit: Where indicated and at vertical exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

D. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
   1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch (102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.
   1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.
1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Ceco Door Products; an Assa Abloy Group company.
2. Curries Company; an Assa Abloy Group company.
3. Deansteel Manufacturing Company, Inc.
4. Gateway.
5. Kewanee Corporation (The).
6. NCS.
7. Rocky Mountain Metals.
8. Steelcraft; an Ingersoll-Rand company.
9. Southwestern Hollow Metal.
10. Windsor Republic Doors.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

E. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

F. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.
G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

H. Glazing: Comply with requirements in Division 08 Section "Glazing."

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.

1. Design: Seamless.
   a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

   a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
4. Top and Bottom Edges: Closed with flush or inverted 16 ga., end closures or channels of same material as face sheets.

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet 16 ga. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet 18 ga. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

1. Fabricate frames with mitered or cope corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Frames for Level 2 Steel Doors: 14 ga. thick steel sheet.

C. Interior Frames: Fabricated from cold-rolled steel sheet 16 ga.
   1. Fabricate frames with mitered or cope corners.
   2. Fabricate frames as full profile welded unless otherwise indicated.
   3. Frames for Level 2 Steel Doors: 16 ga. thick steel sheet.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:
   1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
   2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
   3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
   2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.6 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

2.7 ACCESSORIES

A. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- (6.4-mm-thick by 25.4-mm-) wide steel.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.
2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI-117.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
2. Glazed Lites: Factory cut openings in doors.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
5. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
      1) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      2) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
   b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
      1) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
      2) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.

6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware: include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified on Drawings.

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
3. Provide loose stops and moldings on inside of hollow metal work.
4. Coordinate rabbot width between fixed and removable stops with type of glazing and type of installation indicated.

2.9 STEEL FINISHES

A. Prime Finish All Doors & Frames: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer’s standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbot on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

   a. At fire-protection-rated openings, install frames according to NFPA 80.
   b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
   c. Install frames with removable glazing stops located on secure side of opening.
   d. Install door silencers in frames before grouting.
   e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

   a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.


4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.

6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.

9. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:
   a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
   c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
   d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
SECTION 084113 - ALUMINUM-FRAMED ENTRANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Exterior manual-swing entrance doors and door-frame units.

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
   1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
   2. Dimensional tolerances of building frame and other adjacent construction.
   3. Failure includes the following:
      a. Deflection exceeding specified limits.
      b. Thermal stresses transferring to building structure.
      c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
      d. Glazing-to-glazing contact.
      e. Noise or vibration created by wind and by thermal and structural movements.
      f. Loosening or weakening of fasteners, attachments, and other components.
      g. Sealant failure.
      h. Failure of operating units.

B. Structural Loads:
   1. Wind Loads:
      a. Basic Wind Speed: 100 mph (44 m/s).

C. Deflection of Framing Members:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

G. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).

1. Maximum Water Leakage: According to AAMA 501.1 No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.

H. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
   a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
   b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).
3. Interior Ambient-Air Temperature: 75 deg F (24 deg C).

I. Condensation Resistance: Provide aluminum-framed systems with fixed glazing and framing areas having condensation-resistance factor (CRF) of not less than 45 when tested according to AAMA 1503.
J. Thermal Conductance: Provide aluminum-framed systems with fixed glazing and framing areas having an average U-factor of not more than 0.57 Btu/sq. ft. x h x deg F (3.23 W/sq. m x K) when tested according to AAMA 1503.

K. Sound Transmission: Provide aluminum-framed systems with fixed glazing and framing areas having the following sound-transmission characteristics:

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For adhesives and sealants used inside of the weatherproofing system, including printed statement of VOC content.

C. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

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

E. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
5. Flashing and drainage.

G. Qualification Data: For qualified Installer and testing agency.

H. Welding certificates.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

J. Source quality-control reports.

K. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

L. Warranties: Sample of special warranties.
1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.


E. Source Limitations for Aluminum- Framed Systems: Obtain from single source from single manufacturer.


G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical door.
2. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

H. Preinstallation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration caused by thermal movements.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   d. Water leakage through fixed glazing and framing areas.
   e. Failure of operating components.

2. Warranty Period: Two years from date of Substantial Completion.
B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 20 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Entrance Door Hardware:

1. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of entrance door hardware.
2. Initial Maintenance Service: Beginning at Substantial Completion, provide six months' full maintenance by skilled employees of entrance door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper entrance door hardware operation at rated speed and capacity. Provide parts and supplies the same as those used in the manufacture and installation of original equipment.
3. Continuing Maintenance Proposal: From Installer to Owner, in the form of a standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements:
2. Tubelite: Monumental Doors for entrance framing and doors.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
   2. Glazing System: Manufacturer's standard.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
   1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
   1. Door Construction: 1-3/4-inch (44.5-mm) overall thickness, with minimum 0.125-inch- (3.2-mm-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
      a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
   2. Door Design: As indicated.
      a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches (255 mm) above floor or ground plane.
      a. Provide nonremovable glazing stops on outside of door.

B. Entrance Door Hardware: As specified on Drawings.
2.5 ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:
   a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf ((133 N)) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.
2. References to BHMA Standards: Provide products complying with these standards and requirements for description, quality, and function.

C. Opening-Force Requirements:

1. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force of not more than 15 lbf (67 N) for not more than 3 seconds.
2. Latches and Exit Devices: Not more than 15 lbf (67 N) required to release latch.

D. Refer to Hardware Schedule on Drawings for hardware items.

2.6 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."

1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends cope or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.

E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. High-Performance Organic Finish: 3-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 50 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: Match door colors on existing building.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to evaluate structural-sealant-glazed systems.

B. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing.

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers’ written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
2. Alignment:
   a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
   b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).
B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing under "Performance Requirements" Article, but not more than 0.09 cfm/sq. ft. (0.03 L/s per sq. m), of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure difference of 6.24 lbs/sq. ft. (300 Pa).

2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under "Performance Requirements" Article, but not less than 4.18 lbs/sq. ft. (200 Pa), and shall not evidence water penetration.

3. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet (23 m) by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION 084113
SECTION 085113 - ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes fixed and operable aluminum-framed windows for exterior locations.

B. Related Sections include the following:
   1. Division 08 Section "Aluminum-Framed Entrances and Storefronts" for coordinating finish among aluminum fenestration units.

1.3 DEFINITIONS

A. Performance class designations according to AAMA/WDMA 101/1.S.2/NAFS:
   1. AW: Architectural.
   2. HC: Heavy Commercial.
   3. C: Commercial.
   4. LC: Light Commercial.
   5. R: Residential.

B. Performance grade number according to AAMA/WDMA 101/1.S.2/NAFS:
   1. Design pressure number in pounds force per square foot (pascals) used to determine the structural test pressure and water test pressure.

C. Structural Test Pressure: For uniform load structural test, is equivalent to 150 percent of the design pressure.

D. Minimum Test Size: Smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum windows capable of complying with performance requirements indicated, based on testing manufacturer's windows that are representative of those specified, and that are of minimum test size indicated below:
B. Structural Performance: Provide aluminum windows capable of withstanding the effects of the following loads, based on testing units representative of those indicated for Project that pass AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Structural Test:

1. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour (meters per second) at 33 feet (10 m) above grade, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.

   a. Basic Wind Speed: 100 mph.

2. Deflection: Design glass framing system to limit lateral deflections of glass edges to less than 1/175 of glass-edge length or 3/4 inch (19 mm), whichever is less, at design pressure based on testing performed according to AAMA/WDMA 101/I.S.2/NAFS, Uniform Load Deflection Test or structural computations.

C. Thermal Movements: Provide aluminum windows, including anchorage, that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

   1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C) material surfaces.

1.5 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other work, operational clearances, installation details, and the following:

   1. Mullion details, including reinforcement and stiffeners.
   2. Joinery details.
   4. Flashing and drainage details.
   5. Weather-stripping details.
   7. Glazing details.
   8. For installed products indicated to comply with design loads, include structural analysis data prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of aluminum windows and used to determine the following:

      a. Structural test pressures and design pressures from wind loads indicated.
      b. Deflection limitations of glass framing systems.

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

D. Samples for Verification: For aluminum windows and components required, prepared on Samples of size indicated below.
1. Main Framing Member: 12-inch- (300-mm-) long, full-size sections of extrusions with factory-applied color finish.
2. Window Corner Fabrication: 12-by-12-inch- (300-by-300-mm-) long, full-size window corner including full-size sections of extrusions with factory-applied color finish, weather stripping, and glazing.
3. Operable Window: Full-size unit with factory-applied finish.
4. Weather Stripping: 12-inch- (300-mm-) long sections.

E. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

F. Qualification Data: For Installer, manufacturer, professional engineer and testing agency.

G. Field quality-control test reports.

H. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency for each type, class, grade, and size of aluminum window. Test results based on use of downsized test units will not be accepted.

I. Maintenance Data: For operable window sash, operating hardware, weather stripping, window system operators and finishes to include in maintenance manuals.

J. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project.

1. Installer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
2. Engineering Responsibility: Preparation of data for aluminum windows, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations.

C. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aluminum windows' 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. Provide AAMA-certified aluminum windows with an attached label.
F. Glazing Publications: Comply with published recommendations of glass manufacturers and with GANA's "Glazing Manual" unless more stringent requirements are indicated.

G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup for type(s) of window(s) indicated, in location(s) shown on Drawings. Verify location with Owner.

H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

   1. Failures include, but are not limited to, the following:
      a. Failure to meet performance requirements.
      b. Structural failures including excessive deflection, water leakage, air infiltration, or condensation.
      c. Deterioration of metals, other materials, and metal finishes beyond normal weathering.
      d. Failure of insulating glass.

   2. Warranty Period:
      a. Window: Three years from date of Substantial Completion.
      b. Glazing: 10 years from date of Substantial Completion.
      c. Metal Finish: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. EFCO Corporation.
   2. Kawneer; an Alcoa Company.
   3. Peerless Products Inc.
B. Basis-of-Design Product: Subject to compliance with requirements, provide:
   1. Fixed Double Hung Windows: Kawneer 8450 TL ISOLOK.
   2. Fixed Slider Windows: Kawneer 8470 TL ISOLOK.

2.2 MATERIALS

A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi (150-MPa) ultimate tensile strength, not less than 16,000-psi (110-MPa) minimum yield strength, and not less than 0.062-inch (1.6-mm) thickness at any location for the main frame and sash members.

B. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.

   1. Reinforcement: Where fasteners screw anchor into aluminum less than 0.125 inch (3.2 mm) thick, reinforce interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard, noncorrosive, pressed-in, splined grommet nuts.
   2. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

E. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when aluminum window is closed.
   1. Weather-Stripping Material: Manufacturer's standard system and materials complying with AAMA/WDMA 101/1.5.2/NAFS.


   1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semi-rigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.

G. Replaceable Weather Seals: Comply with AAMA 701/702.

H. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, nonshrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 WINDOW

A. Window Type: As indicated on Drawings.
B. AAMA/WDMA Performance Requirements: Provide aluminum windows of performance indicated that comply with AAMA/WDMA 101/1.S.2/NAFS.

C. Thermal Transmittance: Provide aluminum windows with a whole-window, U-factor maximum indicated at 15-mph (24-km/h) exterior wind velocity and winter condition temperatures when tested according to AAMA 1503.
   1. U-Factor: 0.40 Btu/sq. ft. x h x deg F (2.3 W/sq. m x K) or less.

D. Solar Heat-Gain Coefficient (SHGC): Provide aluminum windows with a whole-window SHGC maximum of 0.40, determined according to NFRC 200 procedures.

E. Sound Transmission Class (STC): Provide glazed windows rated for not less than 26 STC when tested for laboratory sound transmission loss according to ASTM E 90 and determined by ASTM E 413.

F. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/WDMA 101/1.S.2/NAFS, Air Infiltration Test.
   1. Maximum Rate: 0.1 cfm/sq. ft. (2 cu. m/h x sq. m) of area at an inward test pressure of 6.24 lbf/sq. ft. (300 Pa).

G. Water Resistance: No water leakage as defined in AAMA/WDMA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/WDMA 101/1.S.2/NAFS, Water Resistance Test.
   1. Test Pressure: 20 percent of positive design pressure, but not more than 15 lbf/sq. ft. (720 Pa).

H. Life-Cycle Testing: Test according to AAMA 910 and comply with AAMA/WDMA 101/1.S.2/NAFS.

2.4 GLAZING

A. Glass and Glazing Materials: Refer to Division 08 Section "Glazing" for glass units and glazing requirements applicable to glazed aluminum window units.

B. Glass: Clear, insulating-glass units, with low-E coating pyrolytic on second surface or sputtered on second or third surface.

C. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

2.5 HARDWARE

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals.

B. Counterbalancing Mechanism: Comply with AAMA 902.
   1. Manufacturer’s standard.

C. Sill Cap/Track: Extruded-aluminum track with natural anodized finish, of thickness, dimensions, and profile indicated; designed to comply with performance requirements indicated and to drain to the exterior.

D. Fixed Double-Hung Windows: Provide the following hardware:
1. Sash Balances: Two per sash.

2.6 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Fabricate aluminum windows that are reglazable without dismantling sash.

C. Thermally Improved Construction: Fabricate aluminum windows with an integral, concealed, low-conductance thermal barrier; located between exterior materials and window members exposed on interior side; in a manner that eliminates direct metal-to-metal contact.

D. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator.

   1. Horizontal-Sliding Windows: Provide fixed sash with a double row of sliding weather stripping in horizontal rails and single- or double-row weather stripping in meeting or jamb stiles, as required to meet specified performance requirements. Provide compression-type weather stripping at perimeter of each movable panel where sliding-type weather stripping is not appropriate.

E. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

F. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated. Comply with requirements in Division 08 Section "Glazing" and with AAMA/WDMA 101/IS.2/NAFS.

2.7 FINISHES, GENERAL

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

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

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. High-Performance Organic Finish (3-Coat Fluoropolymer): AA-C12C40R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: conversion coatings; Organic Coating: manufacturer's standard 3-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with AAMA 2605 and with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weathertight window installation.

1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing windows, hardware, accessories, and other components.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

E. Separate aluminum and other corrodeable surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.

B. Testing Services: Testing and inspecting of installed windows shall take place as follows:

1. Testing Methodology: Testing of windows for air infiltration and water resistance shall be performed according to AAMA 502, Test Method A, by applying same test pressures required to determine compliance with AAMA/WDMA 101/1S.2/NAFS in Part I “Performance Requirements” Article.

2. Testing Extent: Three windows as selected by Architect and a qualified independent testing and inspecting agency. Windows shall be tested immediately after installation.

3. Test Reports: Shall be prepared according to AAMA 502.
C. Remove and replace noncomplying aluminum window and retest as specified above.
D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.4 ADJUSTING, CLEANING, AND PROTECTION
A. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
B. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.
C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
D. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

END OF SECTION 085113
SECTION 087100 - DOOR HARDWARE

UNIVERSITY OF COLORADO REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes:

1. Items known commercially as finish hardware or builders hardware, required for swing, sliding, or folding doors.

2. Types of finish hardware:
   a. Hinges.
   b. Pivots.
   c. Spring hinges.
   d. Lock cylinders and keys.
   e. Lock and latchsets.
   f. Bolts.
   g. Exit devices.
   h. Push/Pull units.
   i. Sliding door equipment.
   j. Closers.
   k. Overhead holders.
   l. Miscellaneous door control devices.
   m. Door trim units.
   n. Protection plates.
   o. Weatherstripping for exterior doors.
   p. Sound stripping for interior doors.
   q. Automatic drop seals (door bottoms).
   r. Astragals or meeting seals on pair of doors.
   s. Thresholds.
   t. Automatic door operators.
   u. Electrically activated panic hardware.

B. Related Sections:

1. Section 06200 - Finish Carpentry: Installation of finish hardware.
2. Section 08100 - Metal Doors and Frames.
3. Section 08210 - Wood Doors.
4. Section 08740 - Electro-Mechanical Hardware.
5. Hardware for Special Door Units: Refer to applicable special door sections.
6. Divisions 6 and 12: Casework hardware.

1.2 REFERENCES:


B. Fire-Rated Openings:

1. National Fire Protection Association (NFPA) Standard No. 80. This requirement takes precedence over other requirements for such hardware.
2. Underwriters Laboratory (UL).


C. Emergency Exit Devices:

1. Fire-Rated Doors: Provide UL or WHI label on exit devices indicating "Fire Exit Hardware".

1.3 SUBMITTALS:

A. Manufacturer's technical product data of each item of hardware.

B. Hardware Schedule:

1. Organize hardware schedule into "hardware sets" indicating complete designations of every item.
2. Include specific hardware directions for every door opening.

C. Templates:

1. Hardware templates to fabricators of other work which is to receive finish hardware.

1.4 QUALITY ASSURANCE:

A. Supplier Qualifications:

1. Recognized builders hardware supplier, with warehousing facilities, who has been furnishing hardware in the Denver-Metro area for a period of not less than 3 years.
2. Employs an experienced AHC certified hardware consultant, available for consultation during the course of the work.

1.5 WARRANTY:

A. Mechanical failure on door closers for 5 years.

B. Blanket coverage on locksets for 5 years.

C. Failure on parts of all hardware except door closures for 2 years.

PART 2 - PRODUCTS

2.1 HINGES:

A. Manufacturers:

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B. Five knuckle, button tip, full mortise template type with non-rising loose pins and ball or oilite bearings.
C. Exterior Doors: 4 ball bearing, non-ferrous .180 or .190 gage hinges with non-removal pin construction or non-rising loose pin with security set screw.
   1. Doors to 36" Width: 4.5" x 4.5" hinges.
   2. Doors over 36" Width: 5" x 5" hinges.

D. Interior Doors: Ball bearing type, wrought steel construction, with .134 or .145 gage.
   1. Doors to 36" Width: 4.5" x 4.5" hinges.
   2. Doors over 36" Width: 5" x 5" hinges.

E. Number of Hinges:
   1. Minimum 3 hinges per door leaf for doors 84" or less in height.
   2. One additional hinge for each 24" of additional height.

2.2 LOCKS:

A. Manufacturers:

   NOTE: Do not use L9080PEU Version. Reference UCB Standards Section 08740, Part 2.3.

   1. New Construction and Major Rekeying: Schlage L9000 Series (no substitutions) with the following characteristics:
      a. Non-handed case.
      b. Ability to reverse locking hub without opening case cover.
      c. Independent spindles.

   2. Minor Rekeying at Remodel Work: Match existing key system.

B. Heavy duty mortise type.

C. Supply all locks with construction cylinders to secure the building until replaced by Owner with "Medeco" cylinders at job completion. All locks must accommodate "Medeco" cylinders.

D. Lock Throw: 3/4" minimum throw of latch and 1" minimum throw of deadbolt.

E. Trim: Cast lever and cast escutcheon, Schlage Lock Co. #03L (no substitutions).

F. Finish:

   2. Remodel Projects: Match finish of existing hardware in adjacent areas.

2.3 DOOR CLOSERS:

A. Manufacturer:

   1. LCN (no substitutions).
2. Closer Series is 4040 or 4041. may be used with "CUSH" arm if required.
   a. Provide EDA arm (Extra Duty Arm) on parallel arm applications.
   b. Provide "CUSH" arm where required.

3. Through bolted on all doors unless otherwise directed by Owner.


5. Interior Doors: Delayed action and conform to UFAS requirements.

B. Size of Units:
   1. Adjust closers to comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather, wind conditions, and anticipated frequency of use.

2.4 EXIT DEVICES:

A. Manufacturer:
   1. Von Duprin, Inc. (no substitutions).
   2. Vertical rods shall be surface mount only.
   3. Series shall be Von Duprin #99 (or #33 if necessary).

B. Exit Device Dogging: Except on fire-rated doors, wherever closers are provided on doors equipped with exit devices, equip the units with allen-key dogging device to hold the push bar down and the latch bolt in the open position.

C. Fire Rated Exit Devices: Provide with U.L. Label showing listing for "Fire Exit Hardware."

D. Through-bolt on all doors including center cases, end cases, rod guides and latches.

2.5 DOOR TRIM, STOPS, AND HOLDERS:

A. Manufacturers:
   1. Hager
   2. Trimco
   3. Rockwood
   4. Quality
   5. Master Manufacturers, Inc.
   6. Glynn-Johnson
   7. Approved substitute.

B. Door Stops:
   1. Locate in position to permit maximum door swing but not to present a hazard or obstruction.

C. Push/Pull Units and Kick Plates:
1. Manufacturer's standard exposed fasteners.
2. Through-bolted push/pull units for matched pairs, but not for single units.
3. Trim Plates: .050" in thickness.
4. Protection Plates (armor, kick, or mop): Minimum 2" less than door width on stop side and minimum 1/2" less than door width on pull side.
5. Wheelchair Entries: Kickplates shall be a minimum 12" high.

D. Thresholds:

1. Height and slope shall conform to ANSI A117.1 and UFAS requirements.
2. Equip all exterior openings with flat corrugated thresholds, with abrasive surfaces.

A. Overhead Holders:

1. Use surface mounted devices unless otherwise approved by the Owner.
2. Through bolt mount on all doors unless otherwise approved by the Owner.
3. Do not use devices with "hold-open" feature, electromagnetic or otherwise, for doors which are to be used for "airlock" vestibules (typically at exterior doors), or stairwells that serve as vestibules.

B. Automatic Flush Bolts and Coordinators:

1. Do not use automatic flush bolts or coordinators unless otherwise approved by the Owner or required by Code.

2.6 DOOR STRIP UNITS:

A. Manufacturers:

1. Pemko.
2. Reese.
4. Master Manufacturers, Inc.
5. National Guard.
6. Approved substitute.

B. Continuous Weatherstripping:

1. At each edge of every exterior door leaf.
2. At each edge of computer room doors.

C. Smoke Seal Applications: As required to meet all applicable codes.

1. Provide National Guard No. 2525 or approved substitute.

B. Fasteners:

1. Manufacturer's standard exposed fasteners for door trim units (kick plates, edge trim, viewers, knockers, mail drops, and similar units).
2. Noncorrosive fasteners as recommended by manufacturer for application indicated.
C. Weatherstrip and Smoke Seals:
   1. Silicone rubber seal; vinyl not acceptable.

2.7 FINISHES:
   A. Match the finish of the locksets.
   B. Closers: Paint to match locksets.
   C. Thresholds and Weatherstrip Housing: Aluminum with natural aluminum finish.
   D. Coordinate all the various manufactured items furnished on this work to ensure an acceptable uniform finish.

2.8 KEYING:
   A. Final cylinders and keying shall be "Medeco" purchased by the Owner and installed by the Contractor.

2.9 AUTOMATIC DOOR OPERATORS:
   A. Manufacturer:
      1. LCN-Pneumatic only (no substitutions). Power cutoff switch. Reference UCB Standards 08740, Part 2.1, B.
   B. Handicap Accessibility Features: Design system to allow handicap access after-hours when building is secured. Provide devices which may be left turned on after-hours without causing damage or undue wear to the device or any other associated hardware.
   C. Rod and Arm Assembly Shoes: Through bolt on all doors.
   D. Wall Plate Actuators: Hard wire all actuators to electrical supply. Do not use RF (battery operated) actuators.
   E. Key Switches: Must accept Owner-installed cylinders. Provide SDC 700 Series or Von Duprin 900 Series.

2.10 ELECTRICALLY ACTIVATED PANIC HARDWARE:
   A. Manufacturer:
      1. Von Duprin 99EL or 33EL with PS873x2 BB and PT-2 (no substitution except at certain historical locations).

PART 3 - EXECUTION

   Not Used

END OF SECTION 087100
SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART I - GENERAL

1.1 RELATED DOCUMENTS

   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

   A. This Section includes non-load-bearing steel framing members for the following applications:

      1. Interior framing systems (e.g., supports for partition walls, framed soffits, furring, etc.).
      2. Interior suspension systems (e.g., supports for ceilings, suspended soffits, etc.).

   B. Related Sections include the following:

      1. Division 07 Section "Thermal Insulation" for insulation installed with Z-shaped furring members.
      2. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for non-load-bearing metal shaft-wall framing, gypsum panels, and other components of shaft-wall assemblies.

1.3 SUBMITTALS

   A. Product Data: For each type of product indicated.

   B. LEED Submittal:

      1. Product Data for Credit MR 4.1 and Credit MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.

         a. Include statement indicating costs for each product having recycled content.

1.4 QUALITY ASSURANCE

   A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

   B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
PART 2 - PRODUCTS

2.1 NON-LOAD-BEARING STEEL FRAMING, GENERAL

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

2. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized, unless otherwise indicated.

2.2 SUSPENSION SYSTEM COMPONENTS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

   a. Type: Cast-in-place anchor, designed for attachment to concrete forms. Postinstalled, chemical anchor. Postinstalled, expansion anchor.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch (4.12-mm) diameter.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch (1.37 mm) and minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: As indicated on Drawings.

E. Furring Channels (Furring Members):

1. Cold-Rolled Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges, 3/4 inch (19.1 mm) deep.

2. Steel Studs: ASTM C 645.

   a. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).

   b. Depth: As indicated on Drawings.

3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch (22.2 mm) deep.

   a. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).

4. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep members designed to reduce sound transmission.
a. Configuration: Asymmetrical or hat shaped.

F. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   b. Chicago Metallic Corporation; 640-C Fire Front 650-C 660-C Fire Front 670-C Drywall Furring System.
   c. USG Corporation; Drywall Suspension System.

2.3 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).
2. Depth: As indicated on Drawings.

B. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

   a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

      1) Steel Network Inc. (The); VertiClip SLD, VertiTrack VTD Series.
      2) Superior Metal Trim; Superior Flex Track System (SFT).

C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
   b. Metal-Lite, Inc.; The System.

D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.0179 inch (0.45 mm).

E. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch-(12.7-mm-) wide flanges.

1. Depth: 1-1/2 inches (38.1 mm).
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm).
2. Depth: As indicated on Drawings.

G. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped.

H. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare-steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare-steel thickness of 0.0312 inch (0.79 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare-metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type 1 (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   5. Do not attach hangers to steel roof deck.
   6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
   7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
   8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet (3 mm in 3.6 m) measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.5 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

   1. Space studs as follows:

      a. Single-Layer Application: 16 inches (406 mm) o.c., unless otherwise indicated.
      b. Multilayer Application: 16 inches (406 mm), 400 mm o.c., unless otherwise indicated.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

   1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
   2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

      a. Install two studs at each jamb, unless otherwise indicated.
      b. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

   3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
   4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

      a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

D. Direct Furring:

   1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.

E. Z-Furring Members:

   1. Erect insulation (specified in Division 07 Section "Thermal Insulation") vertically and hold in place with Z-furring members spaced 24 inches (610 mm).
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.

3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 092216
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Interior gypsum board.

B. Related Sections include the following:
   1. Division 07 Section "Thermal Insulation" for insulation and vapor retarders installed in assemblies that incorporate gypsum board.
   2. Division 09 Section "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board.
   3. Division 09 Section "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
   4. Division 09 painting Sections for primers applied to gypsum board surfaces.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:
   1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

C. LEED Submittals:
   1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
      a. Include statement indicating costs for each product having recycled content.
   2. Product Data for Credit EQ 4.1: For adhesives used to laminate gypsum board panels to substrates, including printed statement of VOC content.

1.4 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Install mockups for the following:
   a. Each level of gypsum board finish indicated for use in exposed locations.
   b. Each texture finish indicated.

2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
3. Simulate finished lighting conditions for review of mockups.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PANELS, GENERAL

A. Recycled Content: Provide gypsum panel products with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.

B. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
2.2 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. American Gypsum Co.
   b. BPB America Inc.
   c. G-P Gypsum.
   d. Lafarge North America Inc.
   e. National Gypsum Company.
   f. PABCO Gypsum.
   g. Temple.
   h. USG Corporation.

B. Type X: All gypsum board.

1. Thickness: 5/8 inch (15.9 mm).
2. Long Edges: Tapered.

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
   a. Cornerbead.
   b. LC-Bead: J-shaped; exposed long flange receives joint compound.
   c. Expansion (control) joint.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

C. Sound Attenuation Blankets: ASTM C 665, Type 1 (blankets without membrane facing) produced by combining thermostetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
2. Recycled Content: Provide blankets with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.

D. Acoustical Sealant: As specified in Division 07 Section "Joint Sealants."

1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."

F. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

2.6 TEXTURE FINISHES

A. Match wall and ceiling textures in existing building.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.
B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Type X: All gypsum board.

B. Single-Layer Application:
   1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing, unless otherwise indicated.
   2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer’s written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners, unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges Insert requirements.

3.5 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 3: Machine Room and Storage Room.
   3. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

   a. Primer and its application to surfaces are specified in other Division 09 Sections.

3.6 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.

C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions,
texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture-finish manufacturer's written recommendations.

3.7 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900
SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes acoustical panels and exposed suspension systems for ceilings.
B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.3 DEFINITIONS
A. AC: Articulation Class.
B. CAC: Ceiling Attenuation Class.
C. LR: Light Reflectance coefficient.
D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Ceiling suspension system members.
   2. Method of attaching hangers to building structure.
      a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
   3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
   1. Acoustical Panel: Set of full-size Samples of each type, color, pattern, and texture.
   2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.
D. LEED Submittals:

1. Product Data for Credit MR 4.1 and MR 4.2: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
   
a. Include statement indicating costs for each product having recycled content.

2. Product Data for Credit EQ 4.1: For sealants, including printed statement of VOC content.

E. Qualification Data: For testing agency.

F. Field quality-control test reports.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.

H. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.

I. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

B. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
2. Suspension System: Obtain each type through one source from a single manufacturer.

C. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

D. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
   
a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
   
b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
   
a. Smoke-Developed Index: 450 or less.
E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

A. Recycled Content: Provide acoustical panels with recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content constitutes a minimum of 25 percent by weight.

B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

   1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface per ASTM E 795.
2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING

A. Match panels, size, material, texture, and finish in existing portion of building.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

C. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

D. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

   a. Type: Cast-in-place, Postinstalled expansion, Postinstalled bonded anchors.
   b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.

E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

F. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

G. Angle Hangers: Angles with legs not less than 7/8 inch (22 mm) wide; formed with 0.04-inch- (1-mm-) thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation; with bolted connections and 5/16-inch- (8-mm-) diameter bolts.

H. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches (610 mm) o.c. on all cross tees.

I. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.4 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Products: Subject to compliance with requirements, provide products by one of the following manufacturers:
1. Armstrong World Industries, Inc.;
2. BPB USA;
3. Chicago Metallic Corporation;
4. Ecophon CertainTeed, Inc.;
5. USG Interiors, Inc.;

B. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 (Z90) coating designation, with prefinished 9/16-inch- (15-mm-) wide metal caps on flanges.

2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.

2.5 METAL EDGE MOLDINGS AND TRIM

A. Products: Subject to compliance with requirements, provide by one of the following manufacturers:

1. Armstrong World Industries, Inc.;
2. BPB USA;
3. Chicago Metallic Corporation;
4. Fry Reglet Corporation;
5. Gordon, Inc.;
6. USG Interiors, Inc.;

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2.6 ACOUSTICAL SEALANT

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Acoustical Sealant for Exposed and Concealed Joints:
   a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   b. USG Corporation; SHEETROCK Acoustical Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nontag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C 834 and effective in reducing
airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636 UBC Standard 25-2 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
9. Do not attach hangers to steel deck tabs.
10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
11. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:
   a. Install panels in a basket-weave pattern.
2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.
5. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and prepare reports:

1. Suspended ceiling system.
2. Hangers, anchors and fasteners.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using
methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.

1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.

   a. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every 2 postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
   b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.

D. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

3.5 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113
SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY
   A. Section Includes:
      1. Resilient base.
   B. Related Sections:
      1. Division 09 Section "Resilient Sheet Flooring" for resilient sheet floor coverings.
      2. Division 09 Section "Resilient Tile Flooring" for resilient floor tile.

1.3 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. LEED Submittals:
      1. Product Data for Credit EQ 4.1: For adhesives, including printed statement of VOC content.
   C. Samples for Initial Selection: For each type of product indicated.
   D. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches (300 mm) long, of each resilient product color, texture, and pattern required.
   E. Product Schedule: For resilient products. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE
   A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
      1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
   B. Mockups: Provide resilient products with mockups specified in other Sections.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong World Industries, Inc.
   b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
   c. Flexco, Inc.
   d. Johnsonite.
   e. Musson, R. C. Rubber Co.
   f. Roppe Corporation, USA.
   g. VPI, LLC; Floor Products Division.


1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
3. Style: Cove (base with toe), Straight (flat or toeless).
C. Minimum Thickness: 0.125 inch (3.2 mm), 0.080 inch (2.0 mm).

D. Height: 4 inches (102 mm), as shown on Drawings.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Job formed.

H. Finish: As selected by Architect from manufacturer's full range.

I. Colors and Patterns: Black.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

   a. Cove Base Adhesives: Not more than 50 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are same temperature as the space where they are to be installed.
1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:
   1. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 096513
SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Vinyl composition floor tile.

B. Related Sections:
   1. Division 09 Section "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:
   1. Product Data for Credit EQ 4.1: For adhesives, sealants and chemical-bonding compounds, including printed statement of VOC content.

C. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
   1. Show details of special patterns.

D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

E. Product Schedule: For floor tile.

F. Qualification Data: For qualified Installer.

G. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

   1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.
B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class 1, not less than 0.45 W/sq. cm.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups for floor tile including resilient base and accessories.
   a. Size: Minimum 100 sq. ft. (9.3 sq. m) for each type, color, and pattern in locations directed by Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C). Store floor tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
PART 2 - PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   1. Armstrong World Industries, Inc.;
   2. Congoleum Corporation;
   3. Mannington Mills, Inc.;
   4. Tarkett, Inc.;

B. Tile Standard: ASTM F 1066, match existing.

C. Wearing Surface: Smooth.

D. Thickness: Match existing.

E. Size: 12 by 12 inches (305 by 305 mm).

F. Colors and Patterns: Match existing.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

   1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

      a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
   4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
      a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
      b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.
   1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
   1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
   1. Lay tiles to match existing pattern.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer’s written instructions for cleaning and protection of floor tile.

B. Perform the following operations immediately after completing floor tile installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish. Consult with Owner for floor polish material.
   1. Apply three coats.

E. Cover floor tile until Substantial Completion.

END OF SECTION 096519
SECTION 099123 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates:
   1. Steel.
   2. Galvanized metal.
   4. Spray-textured ceilings and walls.
   5. Cotton or canvas insulation covering.

B. Related Sections include the following:
   1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
   2. Division 06 Sections for shop priming carpentry with primers specified in this Section.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of topcoat product indicated.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.

   1. Submit Samples on rigid backing, 8 inches (200 mm) square.
   2. Step coats on Samples to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.

D. Product List: For each product indicated, include the following:

   1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
   2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

E. LEED Submittal:

   1. Product Data for Credit EQ 4.2: For paints, including printed statement of VOC content and chemical components.
1.4 QUALITY ASSURANCE

A. MPI Standards:
   1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

B. Mockups: Apply benchmark samples of each paint system indicated and each color and finish selected to verify preliminary selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
      a. Wall and Ceiling Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
      b. Other Items: Architect will designate items or areas required.
   2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
   3. Final approval of color selections will be based on benchmark samples.
      a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
   1. Maintain containers in clean condition, free of foreign materials and residue.
   2. Remove rags and waste from storage areas daily.

1.6 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.7 EXTRA MATERIALS

A. Deliver left over paint in original, well marked, completely sealed cans to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benjamin Moore & Co.
2. Diamond Vogel Paints.
3. Devoe.
6. PPG Architectural Finishes, Inc.
7. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of Topcoat for use in paint system and on substrate indicated.

B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.

C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anticorrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:

   a. Acrolein.
   b. Acrylonitrile.
   c. Antimony.
   d. Benzene.
   e. Butyl benzyl phthalate.
   f. Cadmium.
   g. Di (2-ethylhexyl) phthalate.
   h. Di-n-butyl phthalate.
   i. Di-n-octyl phthalate.
   j. 1,2-dichlorobenzene.
   k. Diethyl phthalate.
   l. Dimethyl phthalate.
   m. Ethylbenzene.
   n. Formaldehyde.
   o. Hexavalent chromium.
   p. Isophorone.
   q. Lead.
r. Mercury.
s. Methyl ethyl ketone.
t. Methyl isobutyl ketone.
u. Methylene chloride.
v. Naphthalene.
w. Toluene (methylbenzene).
x. 1,1,1-trichloroethane.
y. Vinyl chloride.

D. Colors: Match Architect's samples.

2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.
   1. VOC Content: E Range of E3.
   2. Environmental Performance Rating: EPR 3.

B. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

2.4 METAL PRIMERS

A. Quick-Drying Alkyd Metal Primer: MPI #76.
   1. VOC Content: E Range of E3.

2.5 WOOD PRIMERS

A. Interior Latex-Based Wood Primer: MPI #39.
   1. VOC Content: E Range of E3.
   2. Environmental Performance Rating: EPR 3.

2.6 LATEX PAINTS

A. Interior Latex (Flat): MPI #53 (Gloss Level 1).
   1. VOC Content: E Range of E3.
   2. Environmental Performance Rating: EPR 2.5.

B. Interior Latex (Eggshell): MPI #52 (Gloss Level 3).
   1. VOC Content: E Range of E3.
   2. Environmental Performance Rating: EPR 3.

C. Interior Latex (Satin): MPI #43 (Gloss Level 4).
   1. VOC Content: E Range of E3.
   2. Environmental Performance Rating: EPR 3.5.
D. Institutional Low-Odor/VOC Latex (Flat): MPI #143 (Gloss Level 1).
   1. VOC Content: E Range of E3.
   2. Environmental Performance Rating: EPR 5.5.

E. Institutional Low-Odor/VOC Latex (Low Sheen): MPI #144 (Gloss Level 2).
   1. VOC Content: E Range of E3.
   2. Environmental Performance Rating: EPR 4.5.

F. Institutional Low-Odor/VOC Latex (Eggshell): MPI #145 (Gloss Level 3).
   1. VOC Content: E Range of E3.
   2. Environmental Performance Rating: EPR 4.5.

G. Institutional Low-Odor/VOC Latex (Semigloss): MPI #147 (Gloss Level 5).
   1. VOC Content: E Range of E3.
   2. Environmental Performance Rating: EPR 5.5.

2.7 QUICK-DRYING ENAMELS

A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).
   1. VOC Content: E Range of E3.

B. Quick-Drying Enamel (High Gloss): MPI #96 (Gloss Level 7).
   1. VOC Content: E Range of E3.

2.8 TEXTURED COATING

A. Latex Stucco and Masonry Textured Coating: MPI #42.
   1. VOC Content: E Range of E3.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Masonry (Clay and CMU): 12 percent
   2. Wood: 15 percent.
   3. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
   1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
   2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Clay Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content of surfaces or alkalinity of mortar joints to be painted exceed that permitted in manufacturer's written instructions.

E. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

G. Wood Substrates:
   1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
   2. Sand surfaces that will be exposed to view, and dust off.
   3. Prime edges, ends, faces, undersides, and backsides of wood.
   4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

H. Gypsum Board Substrates: Do not begin paint application until finishing compound is dry and sanded smooth.

I. Spray-Textured Ceiling Substrates: Do not begin paint application until surfaces are dry.

J. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.
3.3 APPLICATION

A. Apply paints according to manufacturer’s written instructions.
   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
   1. Mechanical Work:
      a. Uninsulated metal piping.
      b. Uninsulated plastic piping.
      c. Pipe hangers and supports.
      d. Tanks that do not have factory-applied final finishes.
      e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
      f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
      g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
   2. Electrical Work:
      a. Switchgear.
      b. Panelboards.
      c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

3.4 FIELD QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:

   1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
   2. Testing agency will perform tests for compliance with product requirements.
   3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor
will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Clay-Masonry Substrates:
   1. Latex System: MPI INT 4.1A.
      c. Topcoat: Interior latex (low sheen), (eggshell), (satin).
   2. Institutional Low-Odor/VOC Latex System: MPI INT 4.1M.
      c. Topcoat: Institutional low-odor/VOC interior latex (flat), (low sheen), (eggshell), (semigloss).

B. Steel Substrates:
   1. Quick-Drying Enamel System: MPI INT 5.1A.
      c. Topcoat: Quick-drying enamel (semigloss), (high gloss).
   2. Institutional Low-Odor/VOC Latex System: MPI INT 5.1S.
      a. Prime Coat: Rust-inhibitive primer (water based).
      c. Topcoat: Institutional low-odor/VOC interior latex (flat), (low sheen), (eggshell), (semigloss).

C. Galvanized-Metal Substrates:
   1. Latex Over Waterborne Primer System: MPI INT 5.3J.
c. Topcoat: Interior latex (flat), (low sheen), (eggshell), (satin), (semigloss), (gloss).

D. Dressed Lumber Substrates: Including architectural woodwork, doors.

1. Institutional Low-Odor/VOC Latex System: MPI INT 6.3V.
   c. Topcoat: Institutional low-odor/VOC interior latex (flat), (low sheen), (eggshell), (semigloss).

E. Spray-Textured Gypsum Board Substrates:

   c. Topcoat: Interior latex (flat), (low sheen), (eggshell), (satin), (semigloss).

F. Cotton or Canvas Insulation-Covering Substrates: Including pipe and duct coverings.

1. Institutional Low-Odor/VOC Latex System: MPI INT 10.1D.

END OF SECTION 099123
SECTION 142400 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes hydraulic passenger elevator.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
2. Division 04 Section "Unit Masonry" for setting sleeves, inserts, and anchoring devices in masonry and for grouting elevator entrance frames installed in masonry walls.
3. Division 05 Section "Structural Steel Framing" for the following:
   a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
   b. Structural-steel shapes for subsills that are part of steel frame.
4. Division 05 Section "Metal Fabrications" for the following:
   a. Attachment plates and angle brackets for supporting guide-rail brackets.
   b. Hoist beams.
   c. Structural-steel shapes for subsills.
   d. Pit ladders.
5. Division 09 Section for finish flooring in elevator cars.
6. Division 09 painting Sections for field painting of hoistway entrance doors and frames.
7. Division 26 Sections for electrical service for elevators to and including fused disconnect switches at machine room door and standby power source, transfer switch, and connection from auxiliary contacts in transfer switch to controller.
8. Division 27 Section "Communications Horizontal Cabling" for telephone service for elevators.
9. Division 28 Section "Fire Detection and Alarm" for smoke detectors in elevator lobbies to initiate emergency recall operation and heat detectors in shafts and machine rooms to disconnect power from elevator equipment before sprinkler activation and for connection to elevator controllers.

1.3 DEFINITIONS

A. Definitions in ASME A17.1 apply to work of this Section.

B. Defective Elevator Work: Operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
C. Service Elevator: A passenger elevator that is also used to carry freight.

1.4 SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:

1. Car enclosures and hoistway entrances.
2. Operation, control, and signal systems.

B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed finishes of cars, hoistway doors and frames, and signal equipment; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

E. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service, as shown and specified, are adequate for elevator system being provided.

F. Qualification Data: For Installer.

G. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include diagnostic and repair information available to manufacturer's and Installer's maintenance personnel.

H. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

I. Warranty: Special warranty specified in this Section.

J. Continuing Maintenance Proposal: Service agreement specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain elevators through one source from a single manufacturer.

1. Provide major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.

D. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252, UBC Standard 7-2 or UL 10B.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.

B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.7 COORDINATION

A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.

B. Coordinate sequence of elevator installation with other work to avoid delaying the Work.

C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

1.8 WARRANTY

A. Material and workmanship of installation shall comply in every respect with Contract Documents. Correct defective material or workmanship which develops within one year from date of final acceptance of all work to satisfaction of Owner at no additional cost, unless due to ordinary wear and tear, or improper use or care by Purchaser. Perform maintenance in accordance with terms and conditions indicated in the Preventive Maintenance Agreement.

B. Defective is defined to include, but not limited to; operation or control system failures, car performance below required minimum, excessive wear, unusual deterioration or aging of materials or finishes, unsafe conditions, the need for excessive maintenance, abnormal noise or vibration, and similar unsatisfactory conditions.

C. Make modifications, requirements, adjustments, and improvements to meet performance requirements in Parts 2 and 3.

D. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.
1.9 MAINTENANCE SERVICE

A. Warranty Maintenance:

1. Provide preventive maintenance and emergency callback service for one year commencing on date of final acceptance by Purchaser. Systematically examine, adjust, clean and lubricate all equipment. Repair or replace defective parts using parts produced by the Provider of installed equipment. Maintain elevator machine room, hoistway, and pit in clean condition.
2. Use competent personnel, acceptable to the Purchaser, supervised and employed by Provider.
3. The Warranty maintenance period specified in Item 1 above shall be extended one (1) month for each three (3) month period in which equipment related failures average more than twice per unit per month.
4. Include 24-hour-per-day, 7-day-per-week emergency callback service.
   a. Response Time: Two hours or less.

B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Approved Manufacturers: Alternate Providers must receive approval of Owner at least 14 calendar days prior to bid date.

1. Elevator Control & Landing Systems:
   a. Computerized Elevator Control Corporation;
   b. Elevator Controls;
   c. Minnesota Elevator;
   d. Motion Control Engineering.
2. Hydraulic Systems
   a. CEMCO Lift Elevator Systems;
   b. KONE;
   c. Minnesota Elevator;
   d. Otis;
   e. Schindler;
   f. ThyssenKrupp.
3. Elevator Door Operators:
   a. Elevator Components Industries, Inc.;
   b. GAL Manufacturing;
   c. Motion Control Engineering.
4. Car Enclosure:
   a. Ekhund's Inc.;
   b. Gunderlin, Ltd.;
   c. Hauenstein & Burmeister;
   d. KONE;
   e. Otis;
   f. Schindler;
   g. ThyssenKrupp;
   h. Tyler.
5. Hoistway Entrance:
   a. Hauenstein & Burmeister;
   b. KONE;
   c. Minnesota Elevator;
   d. Otis;
   e. Schindler;
   f. ThyssenKrupp;
   g. Tyler.

6. Fixtures:
   a. EPCO;
   b. GAL Manufacturing;
   c. Innovation Industries.

2.2 SYSTEMS AND COMPONENTS

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard preengineered elevator systems and as required for complete system.

B. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide either of the following:

   1. Pump, with fan-cooled squirrel-cage induction motor, mounted on oil tank with vibration isolation mounts. Enclose pump in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.
   2. Submersible pump, with submersible squirrel-cage induction motor, suspended inside oil tank from vibration isolation mounts.
   3. Provide motor with wye-delta or solid-state starting. Refer to Electrical Drawings.
   4. Provide variable-voltage variable-frequency motor control.

C. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.

D. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.

E. Hydraulic Fluid: Elevator manufacturer's standard fire-resistant fluid with additives as needed to prevent oxidation of fluid, corrosion of cylinder and other components, and other adverse effects.

F. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.

G. Car Frame and Platform: Welded steel units.

H. Guides: Provide either roller guides or sliding guides at top and bottom of car and counterweight frames. If sliding guides are used, provide guide-rail lubricators or polymer-coated, nonlubricated guides.

2.3 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation system for each elevator as required to provide type of operation system indicated.
B. Single-Car Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:

1. Battery-Powered Lowering: When power fails, car is lowered to the lowest floor, opens its doors, and shuts down. System includes rechargeable battery and automatic recharging system.

2. AutomaticDispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors will begin closing.

3. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.

2.4 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.5 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

1. Textured Stainless-Steel Sheet: Product with embossed texture rolled into exposed surface.
   a. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "5WL as manufactured by Rigidized Metals".
   b. Metal surface is satin polished after rolling.

E. Stainless-Steel Bars: ASTM A 276, Type 304.

F. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.


H. Plastic Laminate: High-pressure type complying with NEMA LD 3, Type HGS for flat applications, Type HGL for flat applications, Type HGP for postformed applications and Type BRV for panel backing.

2.6 CAR ENCLOSURES

A. General: Provide steel-framed car enclosures with nonremovable wall panels, with car roof, access doors, power door operators, and ventilation.
1. Provide standard railings complying with ASME A17.1 on car tops where required by ASME A17.1.
2. Provide finished car including materials and finishes specified below.

B. Materials and Finishes: Provide manufacturer's standards, but not less than the following:

2. Floor Finish: Specified in a Division 09 Section Elevator manufacturer's standard level-loop nylon carpet; color as selected by Architect from manufacturer's full range.
4. Plastic-Laminate Wall Panels: Plastic laminate adhesively applied to 1/2-inch (13-mm) fire-retardant-treated particleboard manufacturer's standard honeycomb core with plastic-laminate panel backing and manufacturer's standard protective edge trim. Panels have a flame-spread index of 25 75 or less, when tested according to ASTM E 84. Plastic-laminate color, texture, and pattern as selected by Architect from plastic-laminate elevator manufacturer's full range.
5. Fabricate car with recesses and cutouts for signal equipment.
6. Fabricate car door frame integrally with front wall of car.
7. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet or by laminating stainless-steel sheet to exposed faces and edges of enameled cold-rolled steel doors using adhesive that fully bonds metal to metal without telegraphing or oil-canning.
8. Sight Guards: Provide sight guards on car doors.
9. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
10. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
11. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.

2.7 HOISTWAY ENTRANCES

A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.

1. Where gypsum board wall construction is indicated, provide self-supporting frames with reinforced head sections.

B. Materials and Fabrication: Provide manufacturer's standards, but not less than the following:

1. Enameled-Steel Frames: Formed from cold-rolled or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
2. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
4. Sills: Extruded nickel silver, with grooved surface, 1/4 inch (6.4 mm) thick.

2.8 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with LEDs.
B. Car Control Stations: Provide manufacturer's standard recessed car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.

C. Swing-Return Car Control Stations: Provide car control stations mounted on rear of hinged return panel adjacent to car door and with buttons, switches, controls, and indicator lights projecting through return panel but substantially flush with face of return panel.

1. Mark buttons and switches with standard identification for required use or function that complies with ASME A17.1. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car control station, either integral with car control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

D. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

E. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet, telephone jack in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section "Fire Detection and Alarm."

F. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.

1. Include travel direction arrows if not provided in car control station.

G. Hall Push-Button Stations: Provide one hall push-button station at each landing.

1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
2. Equip units with buttons for calling elevator and for indicating desired direction of travel.
3. Provide telephone jack in each unit for firefighters' two-way telephone communication service specified in Division 28 Section "Fire Detection and Alarm."

H. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide one of the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.
2. Units with flat faceplate for mounting with body of unit recessed in wall and with illuminated elements projecting from faceplate for ease of angular viewing.

I. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on each car.

J. Fire Command Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.
K. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

2.9 ELEVATORS

A. Elevator Description:
   1. Elevator Number(s): 1.
   2. Type: Under-the-car single cylinder.
   3. Type: Holeless, beside-the-car, single-acting, single cylinder.
   4. Rated Load: 2500 lb (1135 kg).
   5. Freight Loading Class for Service Elevators: Class A.
   6. Rated Speed: 125 fpm (0.64 m/s).
   8. Auxiliary Operations:
      a. Battery-powered lowering.
      b. Nuisance call cancel.
   9. Car Enclosures:
      a. Inside Width: 80 inches (2032 mm) from side wall to side wall.
      b. Inside Depth: 51 ¾ inches (1295 mm) from back wall to front wall (return panels).
      c. Inside Height: 96 inches (2438 mm) to underside of ceiling.
      d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
      e. Car Fixtures: Satin stainless steel, No. 4 finish.
      g. Reveals: Enameled steel Polished stainless steel, No. 8 finish Satin stainless steel, No. 4 finish Polished bronze, lacquered Satin bronze, lacquered.
      h. Door Faces (Interior): Polished stainless steel, No. 8 finish, Satin stainless steel, No. 4 finish.
      i. Door Sills: Nickel silver, polished.
      j. Ceiling: Luminous ceiling.
      k. Handrails: 1/2 by 2 inches (13 by 50 mm) rectangular at sides and rear of car.
      l. Floor: Manufacturer's standard carpet.
      m. Floor prepared to receive carpet (specified in Division 09 Section "Sheet Carpeting").
      n. Floor prepared to receive resilient tile (specified in Division 09 Section "Resilient Tile Flooring").
      o. Floor prepared to receive sheet vinyl (specified in Division 09 Section "Resilient Sheet Flooring").

10. Hoistway Entrances:
    a. Width: 42 inches (1067 mm).
    b. Height: 84 inches (2134 mm).
    c. Type: Single-speed side sliding.
    d. Fire-Protection Rating: 1-1/2 hours with 30-minute temperature rise of 450 deg F (250 deg C).
    e. Frames: Enameled steel.
    f. Doors: Enameled steel.
    g. Sills Nickel silver, polished.
11. Hall Fixtures at First Floor at Basement Floors: Polished stainless steel, No. 8 finish Satin stainless steel, No. 4 finish Polished bronze, lacquered Satin bronze, lacquered Recessed type with no exposed-metal surfaces.

12. Hall Fixtures at Other Floors: Satin stainless steel, No. 4 finish.

13. Additional Requirements:

   a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from polished stainless steel, No. 4 finish polished stainless steel.

   b. Provide blanket hooks in all cars and one two Insert number complete set(s) of full-height protective blankets.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

      1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.

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

3.2 INSTALLATION

   A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

   B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

   C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.

   D. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.

   E. Lubricate operating parts of systems as recommended by manufacturers.

   F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

   G. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and direction of travel.

   H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.
I. Locate hall signal equipment for elevators as follows, unless otherwise indicated:
   1. Place hall lanterns either above or beside each hoistway entrance.
   2. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as required and recommended by ASME A17.1 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, adjust, and maintain elevator(s). Refer to Division 01 Section "Demonstration and Training."

B. Check operation of elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

C. Check operation of elevator with Owner's personnel present not more than one month before end of warranty period. Determine that operation systems and devices are functioning properly.

END OF SECTION 142400
SECTION 15010-GENERAL MECHANICAL PROVISIONS

PART 1 GENERAL

1.01 SCOPE

A. General.

1. This Specification Section contains administrative requirements of DIVISION 15.

1.02 WORK INCLUDED

A. Provide complete and operating mechanical systems. The work also includes the completion of details not mentioned or shown which are necessary for the successful operation of all systems; this includes the furnishing of all materials for filling the system to make it operable, including water, refrigerant, oil, grease, antifreeze and brine.

1.03 DRAWINGS

A. Mechanical drawings are diagrammatic and are not to be scaled for dimensions. Take all dimensions from Architectural drawings, certified equipment drawings and from the structure itself before fabricating any work. Verify all space requirements (coordinating with other trades) and install the systems in the space provided without extra charges to the Owner.

1.04 VERIFICATION OF FIELD CONDITIONS

A. Before undertaking each part of the Work, carefully study and compare the Contract Documents with field measurements. Promptly report in writing to the Mechanical Engineer any conflict, error or discrepancy.

1.05 CODES AND STANDARDS

A. Comply with all applicable codes and utility company regulations. In case of conflict with the Contract Documents the most stringent shall govern.

B. Unless otherwise specified, comply with the following codes:

9. UCB Standards 2008

1.06 PERMITS, FEES AND NOTICES

A. Apply for and pay for all permits, fees, licenses and inspections for this Division of Work.

B. The Tap Fees for water and sewer will be paid for by the Owner.
1.07 SUBMITTALS

A. General.

1. Submit data for Mechanical Engineer's approval as required by each Specification Section. Obtain approval from Mechanical Engineer before entering orders for materials and equipment or before performing any related work.

2. The following material may be required to be submitted during the course of the project.

   a. Information for Approval of Substitutions.
   b. Product Data on all Scheduled Equipment on the DRAWINGS.
   c. Product Data on Temperature Control Equipment.
   d. Required Shop Drawings.
   f. Operation and Maintenance Manuals.

B. Review Time.

1. Allow 5 (five) working days for review of submittals. Begin no work until all submittals are returned approved. Engineer shall not be responsible for any project delays due to the review of substitutions.

C. Number of Copies.

1. Except where otherwise indicated, the Contractor shall submit five (5) copies for the Mechanical Engineer's review. Only two (2) copies will be returned to the Contractor with Engineer's and Owner's comments as applicable. If the Contractor requires more returned copies for his use, the Contractor shall submit additional copies.

D. Resubmission Requirements.

1. Make all revisions required by the Mechanical Engineer and resubmit as required for initial submittal.

1.08 SHOP DRAWINGS

A. Submit the following Shop Drawings for approval in accordance with the SUBMITTAL paragraph in this Specification Section:

1. Information for approval of substitutions and/or changes from the DRAWINGS or SPECIFICATIONS.
2. All Temperature Control Systems except those installed by the factory as part factory assembled equipment.
3. Fire Sprinkler System.
4. Refrigeration Piping System.

B. Mechanical Engineer's review of shop drawings does not relieve this Contractor from the responsibility of providing mechanical systems which satisfy the intent of the Contract Documents.

1.09 OPERATION AND MAINTENANCE MANUALS
A. Sheets shall be 8 1/2" X 11", except pull out sheets may be neatly folded to 8 1/2" X 11". Submit three copies to the Mechanical Engineer before final payment. Manuals shall be bound in plastic covered, three ring, loose leaf binder with title of project lettered on front, and the names of all Contractors and Subcontractors who provided materials or services under the Mechanical Sections of these Specifications. The Manual shall contain but not limited to, the following items:

1. Spare parts lists for each piece of equipment.
2. Operating and Maintenance manuals for each piece of equipment including all wiring schematics of factory wired packaged equipment marked up if changed from factory shipped configuration.
3. Schedule of lubrication, filter replacement, and water treatment schedule showing type and frequency of required action. All equipment will be included in this one schedule.
4. Normal operating instruction including a sequence of operation for each system.
5. Instructions as to procedure to be followed for any emergency situation, such as alarms or safety items being tripped.
6. Instructions on who to call for service during guarantee period.
7. All Factory warranties which exceed the one year warranty provided by the Contractor.

1.10 WARRANTIES

A. Guarantee all workmanship, material and equipment and replace any found defective without cost to the Owner, for one year after final acceptance, as defined in General Conditions.

B. Equipment which is factory warranted for a period longer than one year shall be passed on the Owner with the dates that the warranty is in effect. This information shall be inserted in the Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.01 GENERAL

A. All materials and equipment shall be new unless otherwise specified.

2.02 SPECIFIED MANUFACTURERS

A. An acceptable manufacturer's name and model number of a product may be given for an example. This is the equipment contemplated during the design process and forms the basis of a standard of quality. Verify the model number is still accurate and meets all the requirements as shown on the DRAWINGS. If there is a discrepancy between the requirements of the DRAWINGS and the model number, the requirements of the DRAWINGS shall govern. Equals may be allowed unless otherwise noted.

2.03 SUBSTITUTIONS

A. Approval Required.

1. If Contractor is contemplating using materials, equipment, or procedures which are not in accordance with the Contract Documents, the Contractor shall obtain prior approval from the Mechanical Engineer. Mechanical Engineer reserves the right to
refuse the substitution and require the Contractor to provide materials and labor per these Contract Documents. Submit information in accordance with paragraph entitled SUBMITTALS in this Specification Section.

B. Substitution Liability.

1. In making formal request for substitution the Contractor agrees to the following:
   a. Proposed product is equal to or superior in all respects to that which was specified.
   b. Same warranties apply as for the product specified.
   c. To coordinate installation of accepted substitution into the Work, and will make such changes as may be required for the Work to be complete in all respects.
   d. To waive claims for additional costs caused by substitution which may subsequently become apparent.
   e. To pay all redesign costs which may be required.
   f. To pay all additional costs to other Contractors whose work is affected by the substitution.

PART 3 EXECUTION

3.01 PROTECTION OF WORK AND PROPERTY

A. Where there are existing facilities and functions, be responsible for the protection against damage to and interruption of the Owner's operation.

3.02 INSTALLATION OF EQUIPMENT

A. General.

1. Install all work to permit easy removal of coils, heat exchanger tubes (boiler, bundles, chiller), rotating shafts, motors, filters, and all other parts which might require periodic replacement or maintenance. Arrange valves, balancing cocks, and controls for easy access.

B. Space Preference.

1. Ductwork or heating mains shall not have preference over plumbing lines below plumbing fixtures, or over electrical conduits above or below electric switchgear and panels. No piping or ductwork shall be installed over electrical equipment or in required clearances around electrical equipment.

3.03 ELECTRICAL AND MECHANICAL COORDINATION

A. The interface between the General, Mechanical, and Electrical Contractors shall be according to the "HVAC, PLUMBING, AND GENERAL CONTRACTOR COORDINATION SCHEDULE" on the DRAWINGS.

3.04 OPERATIONAL DEMONSTRATION AND TRAINING.

A. Upon completion of all work and all tests, the Contractor shall furnish the necessary skilled labor for operating all systems and equipment installed under the Mechanical Division of the Specifications for a period of 8 hours, or as otherwise specified. The period is purposely
set aside to demonstrate the workability of all systems and to instruct the Owner or his representative, fully in the operations, adjustment, and maintenance of all equipment furnished. Give at least 5 working days notice to the Owner and Mechanical Engineer in advance of the demonstration.

3.05 CLEAN UP

A. At the completion of work, all equipment on the project shall be checked and thoroughly cleaned including any all areas around or in equipment provided under the Mechanical Section. Remove off site all rubbish and debris resulting from the operations and leave all equipment spaces absolutely clean and ready for use.

END OF SECTION 15010
SECTION 15050-BASIC MATERIALS AND METHODS

PART 1 GENERAL

1.01 SCOPE

A. This Specification Section describes the materials and methods common to all sections of DIVISION 15.

PART 2 PRODUCTS

2.01 VALVES

A. General

1. Provide valves as specified herein and as indicated on the Drawings complete with accessories and attachments as required and appropriate.
2. Supply valves for proper pressure ratings determined by the system working pressures at point of use and of proper types for systems and functions indicated.
3. Provide like type valves of one manufacturer only unless specified otherwise
4. plainly and permanently mark valves with manufacturer’s name or trademark, pressure rating, both Water/Oil/Gas (WOG) and Steam Working Pressure (SWP), as applicable and flow direction when required to prevent improper installation.
5. Mark valves requiring approval by Underwriter’s Laboratories (UL) or Factory Mutual Engineering Division (FM) with appropriate markings cast into the valve body.
6. Provide extended necks as appropriate for insulation.
7. Pressure Ratings: Unless otherwise indicated, valves shall be suitable for 200 lb WOG and 250°F.
8. Fire Protection valve shall be in accordance with Section 15300 – Fire Protection

B. Acceptable Manufacturers, subject to compliance with requirements:


C. Ball Valves: Two-piece bronze construction with Teflon seats, full fall port, blowout proof stem and positive shut off with packing nut, suitable for 150 lbs saturated steam or 600 lb non-shock water pressure.

D. Balancing Valves (Piping sizes ½” through 2”): Bronze or brass construction, ball or globe valve type, integral differential pressure read-out ports fitted with check or stop valves, calibrated port opening, non-incremental memory stop, valve designed for positive shut-off.

PART 3 EXECUTION

3.01 VIBRATION CONTROL
A. Equipment.
   1. Install vibration control equipment on all mechanical equipment driven with motors rated over 3/4 HP unless otherwise noted.

B. Pipe Hangers.
   1. Suspend piping connected to all mechanical equipment requiring vibration control equipment with combination spring and rubber hangers for 50 feet from vibrating equipment.

C. Ductwork.
   1. All ductwork connected to mechanical equipment requiring vibration control equipment shall have flexible duct connections. Duct connections shall be double neoprene coated 30 oz. fiberglass fabric, 6" wide, and UL labeled. Thrust restraints shall be provided where necessary to maintain a slack position of the flexible duct connections.

3.02 GENERAL PIPING PRACTICES

A. Installing.
   1. Maintain maximum head room under piping. Install exposed pipe parallel to or at right angles with the lines of the building or with other exposed pipes, care being taken to avoid all windows, doors, or other outlets and not to weaken any structural portion of the building. Make all offsets, bends, reductions, etc. with factory manufactured long radius fittings of corresponding finish, strength, etc., as pipe. No bending shall be allowed. Provide drains with hose connections at low points for draining system.

B. Fittings.
   1. Piping fittings and specialties shall be the same size as the pipe they are installed in, unless otherwise specified. All piping specialties and valves located at pumps shall be same size as the piping shown on the DRAWINGS regardless of the size of the suction and discharge connections of the pump.

C. Unions.
   1. Provide a union or flange connection between equipment and its respective shutoff valve.

D. Dielectric Unions.
   1. Dielectric unions and flanges shall be provided at the following connections between ferrous and non ferrous metals.
      a. Connections between above ground and buried ferrous and non ferrous metallic piping.
      b. Connections between ferrous and non ferrous metallic domestic water, or other open system piping and equipment.
E. Thermometers.
   1. Provide thermometers on each side of equipment where a change in temperature takes place. P/T plugs may be substituted in lieu of thermometers on terminal equipment.

F. Pipe Hangers.
   1. Provide pipe supports to support piping without sagging. Support piping at flexible connections. Provide pipe clamps for vertical pipes at each floor. Provide all supplementary steel angles, channels, and etc. where hanger location falls between joists, purlins or beams. Safety factor of all such assemblies shall be 5 to 1 minimum. Provide inserts between piping and hangers on insulated piping. When hangers contact pipe, hangers shall be of the same material as the pipe, or have a plating of the same material as the pipe. Pipes within walls shall be supported every 6 vertical feet where pipes supply fixtures and within 6 inches of both sides of a control valve.

G. Sleeves.
   1. Provide sleeves wherever pipes pass through masonry walls or floors.
   2. Terminate floor sleeves flush with finished floor. Terminate floor sleeves 1" AFF in toilet rooms, equipment rooms, and chases.
   3. Sleeves shall be large enough to allow for continuous insulation to pass through the sleeve.
   4. Seal sleeves in rated construction with fire barrier caulk.
   5. Seal sleeves in below grade walls with watertight mechanical type compression link seals.

H. Piping Imbedded In Concrete.
   1. Cover all piping either passing through or imbedded in concrete with 1/2" thick closed cell insulation, unless otherwise noted.

I. Escutcheons.
   1. Install escutcheons on exposed pipes passing through walls, floors, and ceilings.
   2. Escutcheons may be deleted in mechanical equipment rooms.

3.03 IDENTIFICATION

A. Equipment.
   1. Permanently identify mechanical equipment with the PLAN CODE as shown on the DRAWINGS.

B. Piping.
   1. Apply pipe markers and directional arrow markers on each pipe. Identification shall be applied every 50 LF, or at least once in each room.

C. Fire Dampers.
   1. Fire dampers shall be identified by stencil painted lettering.

END OF SECTION 15050
SECTION 15900-DUCTWORK AND ACCESSORIES

PART 1  GENERAL

1.01  SCOPE

A. The work of this section consists of providing ductwork, intakes, discharges, fire dampers, and appurtenances, and installing motorized dampers in connection with the heating, ventilating, and air conditioning system.

PART 2  PRODUCTS

2.01  DUCTWORK MATERIALS

A. Galvanized Sheet Metal.
   2. ASTM A525 75 G90 coating (SMACNA 1.25 oz./sq. ft.)

B. Stainless Steel.
   1. AISI type 304 or 316.
   2. ASTM finish type Mill Polish #4.

C. Rigid Fibrous Glass – NOT ALLOWED

D. Hardware.
   1. All associated reinforcing angles, supports, screws, bolts, etc. shall be of same material as sheet metal.

2.02  SPIN-IN COLLARS

A. Spin in collar with butterfly damper with quadrant operator. No damper required on take off to VAV box.

2.03  FLEXIBLE DUCT

A. Spring steel wire helix.
B. Vinyl coated non porous liner.
C. 1” thick insulation.
D. Outer jacket with permeability rating of .75 perms.
E. UL 181 and NFPA approved.

2.04  OPPOSED BLADE DAMPERS

A. Multiple opposed blades.
B. External handle and quadrant type locking device.
C. Blades not to exceed 6” in width.

2.05  FIRE DAMPERS

A. UL listing and label.
B. 1.5 hour fire rating.
C. 165 degree fusible link.
D. Galvanized steel construction.
E. Stainless steel closure spring on horizontal units.

2.06 FIRE/SMOKE DAMPERS

A. UL listing and label.
B. 1.5 hour fire rating.
C. 165 degree thermal disk.
D. Galvanized steel construction.
E. 24V, power-open/spring-return (fail close) actuator.

2.07 SMOKE DAMPERS

A. UL listing and label.
B. 1.5 hour fire rating.
C. Galvanized steel construction.
D. 24V, power-open/spring-return (fail close) actuator.

2.08 DUCT MOUNTED ACCESS DOORS

A. Double galvanized steel with 1" fiber glass insulation (insulation not required when installed in uninsulated ducts).
B. Hinges and Latch.
C. Continuous gasket to seal edges.
D. 12" X 16" minimum size. Where duct size will not accommodate this size door, the door shall be made as large as practicable.
E. Where clearance to building construction is limited, doors shall be removable.

2.09 FIELD ASSEMBLED CASING

A. 16 gage galvanized steel panels with flanged and double standing seam.
B. 1" fiber glass with aluminum foil or neoprene facing securely fastened to panels with adhesive, pins and clips.
C. 1 1/2" X 1 1/2" X 1/8" galvanized steel angle iron located on 4 foot grid to maintain structural rigidity.
D. Full size access door with latch handle on both sides of the door.
E. Seal all joints airtight.

PART 3 EXECUTION

3.01 HVAC DUCTWORK MATERIALS

A. Galvanized Steel Only.

1. Only galvanized steel ductwork shall be installed in the following locations except as otherwise shown on the Drawings or specified in these Specifications:

   a. Drops from rooftop equipment including elbow to turn duct from vertical to horizontal.
   b. In mechanical equipment rooms.
   c. Where exposed to view.
   d. Upstream of VAV terminal units.
   e. Where exposed to weather.
f. Above accessible lay-in ceilings.
g. On the discharge side of VAV terminal units.

3.02 HVAC DUCTWORK CONSTRUCTION

A. Thickness.
   1. Construct ducts in accordance with the SMACNA HVAC Duct Construction Standards unless otherwise noted.

B. Hanging.
   1. Suspend ducts from structure with proper hangers at 4 feet on center and at each floor.

C. Branch Takeoffs.
   1. Do not install takeoffs on elbows or other points of the system where air velocity is not uniform.

D. Volume Dampers.
   1. Volume dampers shall be installed in each branch supply duct takeoff from the main supply duct.

E. Elbows
   1. Elbows shall be long radius type wherever possible, with a centerline radius not less than 1 1/2 times the width or diameter of the duct. Where space does not permit the use of long radius elbows, mitered elbows with factory fabricated turning vanes shall be used.

F. Offsets.
   1. Make all duct offsets with 15 degree transitions. Sharper transitions can be made only when space does not allow 15 degree offsets, 30 degree offsets maximum.

G. Rated Construction.
   1. All ducts penetrating fire rated or smoke rated construction shall be provided with dampers as required by the International Building Code.

3.03 SEALING

H. Low Pressure Ductwork.
   1. Seal all ductwork not located in the conditioned space (including above suspended ceilings) per SMACNA Class B Standards. Seal by using mastic or mastic and tape.

I. High Pressure Ductwork.
   1. All high pressure ductwork must have all seams, joints and connection well sealed by welding or with sealing compounds as recommended by SMACNA.

J. Ductwork Exposed To Weather.
SECTION 15900  

1. All joints shall be watertight by welding, soldering, or duct sealants.

3.04 FLEXIBLE DUCTS

K. Attach all flexible duct inner liner helix to duct connectors, diffuser necks, or ductwork with sheet metal screws 4" on center and stainless steel worm driven clamp. Tape outer vapor barrier securely over clamp with vapor barrier tape. Provide maximum length of 6 feet.

3.05 FIRE, FIRE/SMOKE, AND SMOKE DAMPERS

L. General.

1. Install fire, fire/smoke, and smoke dampers in accordance with NFPA-90A. Coordinate with Fire Alarm Contractor for exact actuator power/voltage requirements before ordering fire/smoke and smoke dampers.

M. Duct Mounted Access Doors.

1. Provide access door in duct large enough to permit raising of damper and installing new heat link.

N. Identification.

1. All fire damper enclosures shall be painted red.

3.06 DUCT MOUNTED ACCESS DOORS

O. General.

1. Provide a duct access door sized and located to permit easy access for future servicing and inspection. In locations where an easily removable grill core will permit sufficient access to the damper, the access door may be omitted.

P. Where Required.

1. Provide access doors at each of the following.

   a. Duct mounted coil.
   b. Duct mounted fan.
   c. Filter bank.
   d. All dampers.
   e. All fire, fire/smoke, and smoke dampers.
   f. Duct mounted equipment not easily removable.
   g. Elsewhere as shown on the DRAWINGS.

3.07 CASINGS

Q. Secure the casing to floors, walls and ceilings by a 2" X 2" X 1/8" galvanized angle iron. Attach angle iron by 1/4" bolts located 12" on center. Seal between angle and building and all joints airtight. Provide access doors to equipment and coils.

3.08 OUTLETS AND INLETS

R. Interior.
1. Coordinate location of all devices with General Contractor and other trades before fabricating ductwork. Fit ceiling mounted units symmetrically into grid pattern of ceilings.

S. Exterior.

1. Coordinate location of all devices with General Contractor and other trades before fabricating ductwork. Provide water proofing as required.

END OF SECTION 15900
SECTION 15990-TESTING, ADJUSTING AND BALANCING

PART 1 GENERAL

1.0 WORK INCLUDED

A. This section covers testing and balancing of environmental systems including but not limited to air distribution systems, hydronic distribution systems, and connected equipment. The testing and balancing of all environmental systems shall be the responsibility of one Testing, Balancing and Adjusting firm. The minimal standards to be met are those set forth in Chapter 36 in the 1999 Edition of the ASHRAE HVAC Applications Handbook.

B. Section 15990 Contractor shall submit bid directly to Division 15 Contractor.

C. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow and water flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
7. Reporting results of the activities and procedures specified in this Section.

1.1 RELATED WORK

A. The General Conditions, Supplementary Conditions and Division 1, General Requirements apply to this section, and Contractor shall review and adhere to all requirements of these documents.

B. Section 15990 Contractor shall review all Sections of Divisions 15 for coordination and extent of work.

1.2 QUALIFICATIONS OF CONTRACTOR

A. The Division 15 Contractor shall directly procure the services of an independent testing and balancing agency specializing in the testing, adjusting and balancing of environmental systems to perform the above mentioned work. Testing and balancing work shall be directly supervised and the results attested to by one of the following:

1. Under the direct supervision of a Registered Professional Engineer having an established office in the State of Colorado and having an experience record of not less than 5 years in the mechanical contracting industry engaged in testing, balancing and adjusting mechanical systems.

2. NEBB Certified Testing, Balancing and Adjusting Supervisor
B. Section 15990 Contractor shall have a minimum of five years of documented experience as a Testing, Balancing and Adjusting Contractor of air and hydronic mechanical systems for not less than two years of that time.

C. Acceptable Section 15990 Contractors
   1. Checkpoint
   2. Finn and Associates
   3. TAB Services
   4. JPG Engineering

1.3 NOTIFICATION OF CONTRACTOR

A. The Division 15 shall submit the name of the TBA firm to the Engineer within thirty days of contract award to ensure that the TBA firm is on the project from the outset of construction.

B. Any TBA firm desiring to offer their services for this work shall submit their qualifications to the Engineer, not less than seven calendar days before the bid date. Approval or disapproval will be given on each request and this action will be given in writing prior to bidding the work.

1.4 STATUS OF SYSTEMS

A. Air and water testing and balancing shall not begin until the system has been completed, cleaned and flushed and is in full working order.

B. Put all heating, ventilating and air conditioning systems and equipment into full operation and continue operation of same during each working day of testing and balancing. Preliminary TBA requirements shall be ascertained prior to the commencement of work through a review of available plans and specifications for the project. In addition, visual observations at the site during construction shall be made to determine the location of required balancing devices and that they are being installed properly for the need.

C. Before any air balance work is done, the system shall be checked for duct leakage, assure filters are installed, see that filters are changed if they are dirty, check for correct fan rotation, equipment vibration, and check automatic dampers for proper operation. All volume control dampers and outlets shall be wide open at this time.

D. Before any hydronic balancing work is done, the system shall be checked for plugged strainers, proper pump rotation, proper control valve installation and operation, air locks, proper system static pressure to assure a full system, proper flow meter and check valve installation. All throttling devices and control valves shall be open at this time.

PART 2- PRODUCTS

2.0 NOT USED

PART 3- EXECUTION

3.0 TEMPERATURE CONTROLS

A. Inspect all temperature control systems for proper sequence of operation and approximate calibration. Report any deficiencies to the responsible contractor immediately.

3.1 REQUIREMENTS OF WORK
A. Balance all air and water flow to terminals within +10% to -5% of design flow quantities. Measure and record the following data.

B. Air Balance

1. Air supply, return and exhaust systems with air quantities for each air device; air handling units including supply, return, mixed and outside temperatures and fan data including CFM, static pressure, fan RPM, motor running and full load amperage before and after final balance.
2. Air diffusion patterns shall be set to minimize objectionable drafts and noise.
3. The supply, return and exhaust fan static pressure shall be set by the balancing firm and the control contractor if the systems have fan volume control dampers.
4. The duct static shall be confirmed both through the instrumentation installed the job and by the balancing contractor.
5. The system shall be tested in all operating modes (full return air, full outside air, modulated damper position, full cooling with the design diversity and full cooling with no diversity).
6. System static pressure and fan motor amperages shall be recorded in all modes.
7. The fan speed resulting in satisfactory system performance shall be determined at full design delivery inlet or outlet. Fan volume control dampers shall be in the wide open position and one path presenting the greatest resistance to flow shall be fully open and unobstructed.

C. Hydronic Balance

1. Heat-Transfer Water Coils
   a. Entering-and leaving-water temperatures.
   b. Water flow rate.
   c. Water pressure drop.
   d. Dry-bulb temperatures of entering and leaving air.
   e. Wet-bulb temperatures of entering and leaving air for cooling coils designed for less than 7500 cfm (3540 L/s)
   f. Airflow
   g. Air pressure drop.

3.2 REPORTS OF WORK

A. The TBA Contractor shall submit six bound copies of the final testing and balancing report at least fifteen days prior to the Mechanical Contractor’s request for final inspection.

1. All data shall be recorded on applicable reporting forms.
2. The report shall include all operating data as listed in paragraph 3.2 above, a list of all equipment used in the testing and balancing work, and shall be signed by the supervising engineering and affixed with his certification seal.

3. Final acceptance of this project will not take place until a satisfactory report is received.

B. Initial Construction-Phase Report: Based on examination of the Contract Documents prepare a report on the adequacy of design for the systems’ balancing devices. Recommend changes and additions to the systems’ devices to facilitate proper performance measuring and balancing. Recommend changes and additions to the HVAC
systems and general construction to allow access for performance measuring and balancing devices.

C. When all balancing is done and all dampers are set, all test holes shall be plugged and all dampers shall be marked. The following information shall be recorded in the final report: Design inlet or outlet size, actual inlet or outlet size, design CFM and velocity thorough the orifice, for each terminal in the system. The pitot tube traverse method for determining CFM shall be used and recorded where ever possible.

D. When all hydronic balancing is done, all valves shall be marked or the locking rings set. Control valve bypass loops shall be set with the balancing valve to provide equal flow in either mode. Confirm in writing.

E. After all balancing is complete and all coordination with the contractor and the engineer is complete, the balancing firm shall furnish a bound report which shall contain the following information:

1. Static pressure across all components of the system.
2. Required and final balanced CFM at each system terminal. Include the terminal size, reading orifice size, and velocities read to attain the CFM.
3. Pump and motor nameplate information, amperage and voltage to all motors, pressure drop across all system terminals, pressure rise across the pump in PSI and feel of head.
4. Thermal protection for all motors shall be recorded. Starter brand, model enclosure type, installed thermal heaters and the rating of the heaters, required thermal heaters and the rating of the heaters if different than installed shall be recorded. If the starters were furnished by the mechanical contractor, the heaters shall be changed to the correct size and so noted in the report. If the starters were furnished by the electrical contractor, the correct heater sizes shall be noted in the report and the electrical contractor shall be advised.
5. The report shall include a sheet which shall report the method of balance, project altitude, and any correction factors used in the calculations.
6. A reduced set of contract drawings shall be included in the report with all terminals (VAV boxes, outlets, inlets, coils, unit heaters, fin tube loops, radiant panel loops, etc.) clearly marked and all equipment designated.
7. Any problems, deficiencies or abnormal conditions that may affect the performance or operation of the systems.

3.3 GUARANTEE OF WORK

A. The TBA Contractor shall guarantee the tests and balance for a period of ninety days from date of final acceptance of the test and balance report. During this period, the TBA Contractor shall make personnel available at no cost to the Owner to correct deficiencies in the balance.

END OF SECTION 15990
SECTION 16010-BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Basic requirements related to Division 16.

B. Related Sections:
   1. Division 1 - General Requirements.
   2. Notice to Bidders - Substitutions.
   3. Division 3 - Concrete.
   4. Division 4 - Elevators.
   5. Division 15 - Mechanical.
   6. Division 9 - Finishes

1.02 REFERENCE CODES AND STANDARDS

A. The electrical design and installations shall meet as a minimum of the most recent versions of the following:
   1. Federal and State regulations.
   2. OSHA
   3. NFPA
   4. NEMA
   5. IEEE
   6. ANSI
   7. NESG
   8. University Standards.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Product Data:
   1. Require shop drawings submittals on the following products to verify that material standards are being satisfied.
      a. Circuit and motor disconnects including fuses.
      b. Low voltage distribution equipment.
      c. Wiring devices.
      d. Luminaires.

PART 3 EXECUTION

3.01 SPECIAL ELECTRICAL PROVISIONS
A. Bidding Requirements

1. The bidder shall give evidence of being able to be bonded to 1½ times project value. A letter shall be provided by the bonding agency assuring capability of bonding this level and associated rates.

2. The successful firm shall be capable of starting work immediately upon receipt of contract award and have the resources to complete the total project in 30 days or less. (Allowance will be made for material delays caused by problems outside of contractor's control, with proper documentation.)

B. Qualification Requirements

1. Contractors bidding this project must complete AIA Document A305-1986 “Contractor's Qualification Statement” and submit it with their proposal for information purposes.

2. In addition to the information requested in Paragraph 1., the Contractor must provide a statement indicating they meet the following minimum requirements:

   a. Macintosh HD: Data: Electrical Standards: Converted: E16010 (Word6) List a minimum of two projects completed in the last five years which were similar in size (or larger), complexity and type. For each project list:

      Name and location of project.

      Name, address and phone number of client/owner and owner's representative.

      Contract type (prime or subcontract) and contract value (or subcontract value).

      Year in which work was performed.

   b. If required list two projects on which the Contractor acted as the prime contractor (may be the same projects listed in Paragraph (a), if applicable).

   c. The firm or its operating officers (above the level of Project Manager) shall have been involved in Electrical Contracting for at least five years.

   d. List project values (or subcontract values, if applicable) which total at least five times job value of electrical work in the last five years completed by the firm or its operating officers.

C. General Requirements

1. The successful firm shall provide a project supervisor of proven experience, and be willing to leave him (or her) on the project for the duration of the project, unless acceptable alternative arrangements are made with the owner.

2. The successful firm must have a business office which is staffed during normal working hours (8:00 - 5:00 Monday through Friday).

3. The project manager of the successful firm shall have paging capability during working hours.

D. Craftsman Regulations

1. Contractors shall include no more than one indentured apprentice per journeyman electrician. Apprentices shall be under the direct supervision of a licensed electrician at all times.

2. Helpers may be assigned to the project as required to do laboring type tasks, but may not do any installation type electrical work.

3. High voltage cable splicers must be certified by the Director of Facilities Management or his (her) Designated Representative, before either cable splicing or terminating begins. Certification requirement must be satisfied by illustrating knowledge by a test demonstration of capabilities. The University of Colorado at Boulder (UCB) will provide cable for test splice, contractor should provide test splice kits per UCB Standard and perform splice for CU High Voltage Department.
Upon completion of requirements, a certification card will be issued by the Department of Facilities Management.

E. Shop Drawing Submittals

1. Shop drawings shall be provided showing the following: \(\frac{1}{4}\)" scaled drawings of electrical rooms, fault calculations and coordination. Equipment wiring diagrams indicating circuit arrangements, bussing, size, electrical ratings, equipment dimensions, weights, equipment arrangements, housing and proposed finishes, and NEMA rating. Equipment requiring this information:

   a. Fire Detection/Alarm Systems and other special systems

F. Construction Requirements

1. It shall be a requirement that the Contractor have available at the job site, current information, on the following at all times:

   a. Construction Plans and Specifications
   b. Addenda
   c. Change Orders
   d. Submittals
   e. Inspection Reports
   f. Test Results
   g. Outage Information and requests
   h. Electrical outages must be held to a minimum. The contractor shall submit a request for the outage to the owner detailing the reasons for the outage, areas affected, sequence of procedures to accomplish work, estimated maximum length of time, the date and time of day outage will occur. The Contractor shall obtain written authorization from the owner fourteen calendar days prior to all outages. Due to the critical implications of power outages, the owner may direct the contractor as to the time of day or night and date an outage may take place. The Contractor will be responsible for any temporary power required.
   i. As-built Drawings (showing all changes)

3.02 MAINTENANCE

A. Maintenance Service:

1. As part of the service and instruction manuals for the project, the Contractor shall be required to submit schematic diagrams and point-to-point wiring diagrams for the following systems. Submittal shall be in the form of blacklines, furnish reproducible copy (mylar sepia), and AutoCAD latest version.

   a. Fire Detection/Alarm Systems

3.03 PROJECT CLOSEOUT

A. Operating and Acceptance Tests

1. The Contractor shall hire an independent testing agent to conduct operating and acceptance tests on new electrical system components and all existing devices which are impacted by the project.
2. The Testing agent shall prepare written reports of values of all test readings and procedures. Reports shall include all breaker settings and modifications to one line and three line drawings.
3. The Testing agent shall furnish all equipment, instruments and personnel required to conduct tests.
4. Test will be defined in the individual section describing the equipment or system.

B. Punch Lists
   1. Final payment will not be authorized until all items on the final punch list have been completed, and routine maintenance procedure and spare parts have been received.

C. Cleaning and Conduit Painting
   1. Clean all electrical equipment, such as switches, panelboards, luminaires, etc., of construction dirt, dust, paint smears, etc., and touch-up or repaint all scars, blemishes, rust spots, etc., to original or approved other state of finish.

D. Operation and Maintenance Manuals
   1. Compile a complete list of product data and shop drawings, acceptance tests, warranties, certificates, sub-contractor and supplier information (i.e. name, address, and phone no.).

E. Guarantees and Warranties
   1. Furnish to the Owner a formal warranty covering the electrical system installed under this contract, to be free from defective materials and workmanship for a period of one year after date of acceptance of installation by Owner. During this period provide all labor and new materials required to repair or replace all defects to the satisfaction of the Owner at no cost to Owner.

F. As-built Drawings
   1. The Contractor shall provide to the Architect/Engineer a contract set of electrical drawings and CAD files, both hard copy and electronic copy with all CAD and clouded changes and deviations from the original drawings.

G. Emergency Lighting
   1. All emergency lighting installed shall be commissioned. Commissioning shall be performed by UCB electrical engineer and contractor by walking. Areas of emergency egress lighting during non daylight hours and taking footcandle measurements where areas do not meet code, emergency lighting shall be added at NO COST to the university.

END OF SECTION 16010
SECTION 16110 - RACEWAYS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Rigid metal conduit and fittings.
2. Intermediate metal conduit and fittings.
3. Electrical metallic conduit and fittings.
4. Flexible metal conduit and fittings.
5. Liquid tight flexible metal conduit and fittings.
6. PVC coated rigid metal conduit and fittings.
7. Non-metallic conduit and fittings.
8. Cable trays.
9. Under floor duct.
10. Surface wireways.

B. Related Sections:

1. Section 01045 - Cutting and Patching
2. Section 02225 - Trenching, Excavation and Backfill
3. Section 03300 - Cast-In-Place Concrete: Protective envelope for underground conduit installations.
4. Section 07620 - Sheet Metal Flashing and Trim

1.02 References

A. Specify Underwriters Laboratories (UL) listed equipment, assemblies and materials.

B. Where appropriate, refer to current ANSI and NEMA Standards for material ratings.

PART 2 PRODUCTS

2.01 MATERIALS

A. Electrical Metallic Tubing
   1. All steel set screw fittings for interior locations.
   2. All steel set compression fittings for exterior locations.

B. Flexible Metal Conduit:
   1. Galvanized steel with all steel fittings. Compression type fittings (squeeze types).

C. Liquid Tight Flexible Metal Conduit:
   1. Galvanized steel with plastic jacket.
   2. Liquid Tight Flexible Metal Conduit: Specify fittings which provide grounding continuity.

D. Prohibited Materials:
   1. Use of aluminum conduit is specifically prohibited unless special permission is given by
      Department of Facilities Management.
   2. Use of extra-flexible, non-labeled conduit is prohibited.
   3. ENMT (or Electrical Non-Metallic Tubing) is prohibited.
   4. MC Cable is prohibited.

E. Surface Wireways:
   1. Steel with factory applied paint finish or natural brushed or stainless steel finish. Coordinate
      finish selection with Department of Facilities Management prior to final design.

PART 3 EXECUTION

3.01 INSTALLATION APPLICATION

A. Conduit Sizing, Arrangement and Support:
   1. Conduit Size:
      a. For "power" receptacle circuits, the minimum conduit size shall be 3/4" in all buildings.
         For lighting circuits the minimum conduit size shall be 3/4".
      b. Size conduit (for receptacle circuits, motor circuits, other circuits delivering power to
         devices who's utilization is not producing light, and panelboard feeders only) to meet
         requirements of National Electric Code insulation type RH, RHW, RHH. Lighting
         circuits shall comply with appropriate insulation fill tables.
2. Flexible Conduit Size:
   a. Minimum flexible conduit size shall be 3/4" with exception for a 6' maximum length whip from j-box to light fixture may be 1/2".
   b. For power circuits, in compliance with 3.01.A.1.
   c. Maximum length of flexible conduit is 3' except for connections to lighting equipment which may be up to 6' maximum length.
   d. 3/8" flexible conduit is permitted if furnished as part of a manufactured equipment connection (including lighting equipment).

3. Conduit Straps and Hangers:
   a. Heavy-duty malleable iron or steel.
   b. For locations above grade which are subject to moisture or corrosion, specify corrosion resisting steel.
   c. Perforated pipe strap or wire hangers are not permitted.
   d. Support conduits above suspended ceilings from building structure by suitable hangers. Supporting conduits from ceiling suspension wires is not permitted.

4. Conduit Anchors:
   a. Plastic or fiber expansion anchors are prohibited.
   b. Powder activated anchors are allowed.

B. Conduit Installation - Interior:

1. Electrical Metallic Tubing: Shall be used or specified for the following locations:
   a. Interior partitions.
   b. Above ceilings.
   c. Prohibited in hazardous or corrosive areas.
   d. Exterior walls, above grade.
   e. Prohibited in concrete slabs or walls.
   f. Prohibited below grade.

2. Flexible Metal Conduit: Specify for the following locations:
   a. Motor final connections.
   b. Transformer final connections.
   c. Mechanical equipment final connections.
   d. Lighting equipment final connections.
3. Liquid Tight Flexible Metal Conduit: Specify for the following locations:
   a. Outdoor installations.
   b. Damp or wet installations.
   c. Corrosive installations.
   d. Motors in wet, damp locations or subject to oil drip.
   e. Final 3 foot connection to all sprinkler and preaction valves.


5. Expansion Joints: Specify suitable expansion fittings where conduits cross expansions joints. Specify steel fittings which provide grounding continuity.

6. Incompatible Materials: Do not permit use of dissimilar metal fittings on raceway systems. All fittings and conduits must be compatible.

7. All surface mounted conduit shall be painted to match surface mounted upon. Use paint appropriate for conduit application.

8. Label all conduits i.e. Power 120/208, Lighting 277, telecom, control.

C. Surface Raceways:

1. Require electrical continuity of all raceway components throughout length of system.

END OF SECTION 16110
SECTION 16120 - WIRE AND CABLE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Building wire.
   2. Remote control and signal cable.
   3. Wiring connections and terminations.

B. Related Sections:
   1. Section 16110 - Raceways

1.02 REFERENCES

A. Specify Underwriters Laboratories (UL) listed equipment, assemblies and materials.
B. Where appropriate, refer to current NEMA Standards for material ratings.

PART 2 PRODUCTS

2.01 BUILDING WIRE

A. Thermoplastic - Insulated Wire:
   1. Types THW, THHN, THWN; rating 600V.

C. Conducted Material:
   1. Conductors #10 AWG and larger, stranded copper.
   2. Conductors smaller than #10 AWG, solid copper.

D. Control Wire:
   1. Stranded copper with 600V insulation.

2.02REMOTE CONTROL AND SIGNAL CABLE

A. Class 1, 2, or 3:
   1. Copper conductor, 300V insulation, rated 60°C, covered with PVC jacket.
   2. All control and signal cables shall be in conduit.
2.03 MODULAR WIRING SYSTEMS

A. Not allowed.

2.04 TERMINATION

A. Splices and taps are to carry full ampacity of conductors without perceptible temperature rise.

PART 3 EXECUTION

3.01 GENERAL WIRING METHODS

A. Device removal - in multi-wire branch circuit - where a circuit extends through a receptacle, it shall be a requirement that all conductors shall be pigtailed so downstream load does not go through receptacles.

B. Where harmonic currents exist on circuits supplying electric discharge lighting, data processing or similar equipment, a full sized neutral shall be provided for each single phase circuit, and an oversized neutral may be required for each multi-wire circuit.

C. Wire Sizing:

1. Minimum wire size of #12 AWG for power and lighting circuits.

2. Minimum wire size #14 AWG for control circuits.

3. For 20 ampere 120V circuits longer than 75’, #10 AWG conductors.

4. For 20 ampere 277V circuits longer than 150’, #10 AWG conductors.

5. For circuit amperes other than 20 ampere and for distances greater than listed above, calculate voltage drop and size conductors for maximum 3% voltage drop.

D. Wire Color Coding:

1. Color code wires for building voltage classes as follows:

   120/208V-3Ø
   ØA - Black
   ØB - Red
   ØC - Blue
   Neutral - White
   Ground - Green

   277/480V-3Ø
   ØA - Brown
   ØB - Orange
   ØC - Yellow
   Neutral - Gray
   Ground - Green

E. Parallel Conductors:

1. Specify that parallel conductor feeders be installed so that all runs are of identical equal length.

F. Insulation Ratings:

1. All conductors shall be specified 600V rated.

2. Insulation types specified shall conform to NEC requirements for temperature, moisture, and mechanical environmental conditions.
3.02 WIRING INSTALLATION IN RACEWAYS

A. Wire Pulling:
   1. Conductors shall be pulled into conduit at the same time.
   2. Use UL listed wire pulling lubricant.
   3. Conduit shall be swabbed clean before wire is pulled in.

B. Length of conductors at receptacles, junction, and switches at least 6" of free conductor shall be left at each outlet, junction and switches for splices or connection of fixtures or devices.

3.03 CABLE INSTALLATION

A. Cable Protection:
   1. Provide protection for cables where subject to mechanical damage.

3.04 WIRING CONNECTIONS AND TERMINATIONS

A. General Requirements:
   1. Conductors shall be spliced only in accessible junction boxes or wireways.
   2. Conductors shall be thoroughly cleaned before installing lugs or connectors.
   3. An equipment grounding conductor(s) shall be installed in all branch circuit raceways.

3.05 QUALITY CONTROL

A. Feeders:
   1. Feeder to elevator shall be tested for continuity and insulation (meggar) resistance. Minimum four (4) meg.

END OF SECTION 16120
SECTION 16130-BOXES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Wall and ceiling outlet boxes.
   2. Pull and junction boxes.

B. Related Sections:
   1. Section 16110 - Raceways
   2. Section 16510 - Lighting fixtures

1.02 REFERENCES

A. Where appropriate, refer to current ANSI and NEMA standards.


PART 2 PRODUCTS

2.01 OUTLET BOXES

A. Sheet Metal Outlet Boxes:
   1. Galvanized steel, 4” square minimum with a 2” box depth minimum and with plaster ring.

B. Cast Boxes:
   1. Cast ferroalloy, deep type with gasketed cover, threaded hubs.

2.02 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes:

B. Sheet Metal Boxes Over 12” In Any Dimension (cabinet shall comply with requirements of 16160.2.01.B.1.)

C. Boxes For Outdoor And Wet Locations:
   1. Flat flanged, surface mounted, UL listed as raintight, galvanized cast iron box and cover with neoprene gasket and stainless steel cover screws.
D. Boxes For Buried Flush Grade Locations:
   1. Flat flanged, UL listed as watertight, galvanized cast iron, aluminum or PVC box and cover with neoprene gaskets.

2.04 BOX EXTENSIONS
   A. Prohibited on new construction.
   B. One extension is permitted on remodel work to extend existing installations. Where more than one box is needed to flush out installation, provide a large (i.e. 6"x6") box to flush out the existing box and nipple over to a new box.

PART 3 EXECUTION

3.01 BOX LOCATIONS
   A. Provide electrical boxes to accommodate wire pulling, splices, taps, equipment connections and code compliance.
   B. Electrical Contractor shall furnish to G.C., access doors as required to provide access to boxes in hard ceilings and similar inaccessible areas.
   C. Provide cast box (with threaded hubs) in high traffic areas (surface installations), as specified by owner.

3.02 OUTLET BOX INSTALLATIONS
   A. Back to back outlet boxes are not permitted. Separate boxes a minimum of 6" in standard walls and a minimum of 2 feet in acoustical walls.
   B. Install knockout closures for unused openings.
   C. Blank cover plates shall be used in all unused boxes.
   D. For multiple device installations, multi-gang boxes shall be provided. Sectional boxes are not permitted. Install barrier separation of different voltage conductors in the same box.
   E. Thoroughly coordinate casework and backsplash heights with mounting heights of boxes.
   F. Provide recessed outlet boxes in finished areas, supported from interior partition studs. Supports are to be stamped steel stud bridges for hollow stud walls and adjustable steel channel fasteners for flush ceiling outlet boxes.
   G. Provide back supports for boxes in metal stud walls.

3.03 PULL AND JUNCTION BOX INSTALLATION
   A. Wherever possible, locate pull and junction boxes above accessible ceilings in finished areas.
   B. Pull or junction boxes shall be supported independently of conduit.

END OF SECTION 16130
SECTION 16140-WALL SWITCHES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide wall switches for control of lighting, receptacles and all other required functions.

1.02 SHOP DRAWINGS AND DESCRIPTIVE DATA

A. Shop drawings and descriptive data shall be submitted in accordance with Section 16010 and shall, as a minimum, include the following:

   1. Manufacturer's complete catalog data.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURES

A. Wall switches, receptacles and plates shall be of the same manufacturer insofar as possible.

B. Wall switches shall be as manufactured by:

   1. Hubbell
   2. Leviton
   3. Arrow-Hart
   4. P&S

C. Products shall comply with Federal specification W-S-896E.

2.02 MATERIALS

A. 120/277 volt wall switches shall be specification grade rated 20 amperes and shall be quiet quick make, quick break with toggle handle, and totally enclosed case. Other ampere switches may only be used with UCB permission.

B. Two pole, 3-way and 4-way switches shall be of the same construction.

C. Key operated switches shall be same as above except with locking type mechanism.

D. Switches shall have color coded bodies as follows:
   20A - Red
   30A - Green

E. Switches with pilot light shall be the same as above except that switches shall be equipped with and connected to an integral pilot light.

F. Switches shall be in accordance with the following schedule:
DEVICE                      HUBBELL CATALOG NO.
Single Pole Switch          1221
Single Pole Switch with Pilot Light (120 V - load on) 1221-PLC
2 Pole Switch               1222
3-Way Switch                1223

G. Switch color to be ivory unless otherwise specified. Verify color with Architect prior to ordering.

H. Switch for life safety circuits shall be red.

I. Grounding screw on all devices.

PART 3 EXECUTION

3.01 INSTALLATION

A. Switches shall be located as indicated on drawings, arranged singular or in gangs and within 18” of the door jam on the strike side of the door openings. Verify the door swings with the Architectural drawings prior to rough-in.

B. Install life safety system switches separate from normal power switches. Do not include in the multiple gang configuration.

C. Switch and receptacle combinations shall be as above in a 2-gang box where both are of the same voltage. Provide separate boxes where different voltages are present.

D. All switches in Mechanical rooms, Electrical rooms and other such places shall be a lighted handle single pole light switch(es) as required.

E. Provide circuit and panelboard identification on outside of all switch plates with electronic label maker.

END OF SECTION 16140
SECTION 16141-RECEPTACLES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Provide convenience receptacles as herein specified or called for on the drawings.

1.02 SHOP DRAWINGS AND DESCRIPTIVE DATA

A. Shop drawings and descriptive data shall be submitted in accordance with Section 16010 and shall, as a minimum, include the following:

B. Manufacturer’s complete catalog data.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Wall switches, receptacles and plates shall be of same manufacturer insofar as possible.

B. Receptacles shall be as manufactured by:

1. Hubbell
2. Daniel Woodhead
3. Leviton
4. Cooper
5. P&S

2.02 MATERIALS

A. Materials shall comply with federal specification W-C-596E.

B. Receptacles shall be specification grade and shall be of the grounding type. Provide grounding screw.

C. Receptacles shall have a one piece brass strap.

D. Receptacles shall be in accordance with the following schedule:

<table>
<thead>
<tr>
<th>DEVICE</th>
<th>HUBBELL CATALOG NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplex Receptacle, 20A, 125V</td>
<td>5362</td>
</tr>
<tr>
<td>Duplex Receptacle, 20A, 125V, Ground Fault</td>
<td>GF-5362</td>
</tr>
</tbody>
</table>

E. Device color to be ivory unless otherwise specified. Verify color with Architect prior to ordering.

F. Device color for life safety circuits shall be red.

PART 3 EXECUTION

3.01 INSTALLATION
A. Furnish and install all devices as shown on drawings. Confirm location, height, mounting conditions, etc., of all devices with Architectural drawings prior to rough-in.

B. Convenience outlets shall be mounted such that the front of the device is flush with the cover plate.

C. Over-counter devices shall be horizontally mounted, ground to the right.

D. Switch and receptacle combinations shall comply with Section 16141.

E. Where convenience outlets or similar devices are installed within one stud spacing width from a switch, the convenience outlet and switch shall align vertically.

F. Provide separate green ground wire for all isolated ground receptacles

G. Provide hospital safety grade receptacles in all areas associated with children.

H. Provide heavy duty specification grade receptacles in all areas.

I. Vertical mounted receptacles to be installed with the ground up.

J. Provide circuit and panelboard identification on the outside of all receptacle plates with embossed tape, or electronic label maker per section 16195.

END OF SECTION 16141
SECTION 16142-DEVICE PLATES

PART 1  GENERAL

1.01 WORK INCLUDED

A. Provide device plates as required and indicated on the drawings.

1.02 SHOP DRAWINGS AND DESCRIPTIVE DATA

A. Shop drawings and descriptive data shall be submitted in accordance with Section 16010 and shall, as a minimum, include the following:

B. Manufacturer’s catalog data.

PART 2  PRODUCTS

2.01 ACCEPTABLE MANUFACTURES

A. Wall switches, receptacles and device plates shall be by same manufacturer as devices. (Hubbell, Daniel Woodhead, Leviton, Arrow-Hart, Eagle, P&S)

2.02 MATERIALS

A. Smooth Metal: Stainless steel

B. Smooth Lexan: In all locations unless otherwise directed.

C. Wrinkle Finish: Steel, finish to be painted, color to be ivory unless otherwise noted.

D. Cast Metal or Aluminum: Die cast profile, ribbed for strength, flash removed, primed with gray enamel.

E. Gaskets: Resilient rubber or closed cell foam urethane.

F. Weatherproof: Cast metal or aluminum, gasketed; provide spring loaded gasketed doors. All devices in areas subject to frequent use shall be “in-use” type of covers.

PART 3  EXECUTION

3.01 INSTALLATION

A. Install device plates as required for all devices boxes and blanked outlet boxes.

B. Plate color shall be ivory unless otherwise specified.

C. All light switch device plates in classrooms shall be metal engraved nameplates and labeled with circuit, and panel identification on the lights controlled. Light switches shall be labeled as to lights controlled, receptacles with feeding circuit. All device plates elsewhere shall be labeled per direction in 16140 and 16141.

END OF SECTION 16142
SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Nameplates and tape labels.
   2. Wire and cable markers.

B. Related Sections:
   1. Section 09900 - Painting
   2. Section 16110 - Raceways
   3. Section 16130 - Boxes
   4. Section 16140 – Wall Switches
   5. Section 16141 - Receptacles
   6. Section 16470 - Panelboards

PART 2 PRODUCTS

2.01 MATERIAL

A. Nameplates:
   1. Engraved three-layer laminated plastic, black letters on white background.
   2. Life safety and emergency shall be white letters on red background.

B. Electronic Labels:
   1. Manufacturers:
   2. Kroy
   3. Brother
   4. pre-approved equal

C. Wire and Cable Markers:
   1. Cloth markers, split sleeve or tubing type.

D. Embossed labels prohibited
PART 3  EXECUTION

3.01 INSTALLATION

A. Nameplates and Labels:
   1. Provide the following:
      a. Degrease and clean surfaces to receive nameplates and labels.
      b. Install nameplates parallel to equipment lines.
      c. Secure nameplates to equipment using screws or rivets. Locate nameplates on outside face of panelboard doors in finished locations.
      d. Electronic labels will be permitted only for identification of disconnects, individual wall switches (in unfinished areas), control station devices and starters, and on outside face of receptacles and wall switch plates.

B. Wire Identification:
   1. Provide the following:
      a. Provide wire markers on each conductor at points of termination in panelboards, outlet and junction boxes and at load connections. Identify with branch circuit or feeder number for power and lighting circuits and with control circuit number for control wiring. Install wire markers in panelboard between deadfront and edge of can.

3.02 NAMEPLATE ENGRAVING SCHEDULE

A. For engraving, identification shall be the name of the device, panelboards, etc. The “voltage, load serve” line also shall include the name of the feeding panel, switchboard, etc.

B. Switchboards and Motor Control Centers:
   1. Identification:
      a. 1/2” high lettering.
   2. Voltage, Loads Served:
      a. 1/4” high letters.

C. Panelboards:
   1. Identification:
      a. 1/2” high lettering
   2. Voltage:
      a. 1/4” high lettering.
D. Switches, Starters, Receptacles:
   1. Identification:
      a. Electronic tape or neatly written permanent ink on inside faceplate in finished areas.

3.03 PULL AND JUNCTION BOX COLOR CODING

A. For ease of identification during maintenance and remodeling, junction box covers shall be color coded according to the following schedule:

   1. Fire Alarm - Red
   2. Emergency Circuitry - Yellow
   3. Telephone - Green
   4. Television - Violet
   5. Computer Data - Blue
   6. 277/480V Systems - Orange

END OF SECTION 16195
SECTION 16440-DISCONNECT SWITCHES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Disconnect switches.
   2. Enclosures.

1.02 REFERENCES

A. Specify Underwriters Laboratories (UL) listed equipment, assemblies and materials.

B. Where appropriate, refer to ANSI and NEMA Standards for material ratings.


1.03 SUBMITTALS

A. Require submittals under the provisions of Section 16010 - Basic Electrical Requirements and Section 01300 - Submittals.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Disconnect Switches:

   1. General Electric
   2. Westinghouse/Cutler Hammer
   3. ITE/Siemens
   4. Square D

2.02 MATERIALS

A. Disconnect Switches:

   1. Fusible Switch Assemblies (NEMA KS-1):

      a. Heavy duty rated, quick-make, quick-break, load interrupter enclosed knife switch, with externally operable handle with override screw to permit opening front cover with switch in “ON” position. Handle lockable in “OFF” position. Class R rejetion fuse clips, designed to accommodate required fuses.
2. Non-Fusible Switch Assemblies: (NEMA-KS-1)
   a. Heavy duty rated, quick-make, quick-break, load interrupter enclosed knife switch, with externally operable handle with override screw to permit opening front cover with switch in “ON” position. Handle lockable in “OFF” position.

3. Enclosures:
   a. Suitable for environment in which installed; indicate on Drawings. Typically Type 1 indoors and Type 3R outdoors.

PART 3 EXECUTION

3.01 INSTALLATION

   A. Provide disconnects for all motors and mechanical equipment. Locate adjacent to units per NEC.

   B. Coordinate fusing of disconnects with mechanical equipment electrical characteristics.

END OF SECTION 16440
SECTION 16470-PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Lighting and appliance branch circuit panelboards.

B. Related Sections:

1. Section 16195 - Identification

1.02 REFERENCES

A. Provide Underwriters Laboratories (UL) listed equipment, assemblies and materials.

B. Where appropriate, refer to current ANSI and NEMA Standards for material ratings.

1. NEMA AB 1 - Molded case circuit breakers.
2. NEMA PB 1 - Panelboards
3. NEMA PB 1.1 - Installation for safe installation operation and maintenance of panelboards.


1.03 SUBMITTALS

A. Require submittals under the provisions of Section 16010 - Basic Electrical Requirements and 01300 - Submittals.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement and sizes.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Panelboards:

1. General Electric
2. Westinghouse/Cutler Hammer
3. ITE - Siemens
4. Square - D

2.02 MATERIALS

A. Panelboards:

1. Panelboard Assembly:
a. Bolt on, circuit breaker type, cabinet front with concealed trim clamps door in door construction and flush lock, finished in manufacturer's standard enamel. Provide with copper bus rated at 120/208V or 277/480V, 10 or 30A. Also provide ground bus and full size neutral bus. Current rating 100, 225, 400 or 600 amperes with minimum integrated short circuit rating: 10,000 amperes rms. symmetrical, 120/208V and 14,000 amperes rms. symmetrical 277/480V.

b. Panelboard types shall be as indicated below for the type of purposes indicated. Type codes noted for illustration are by General Electric.

(1) General purpose lighting, 277/480V - NHB
(2) General purpose lighting and receptacles, 120/208V - NLAB
(3) Power distribution, 277/480V - CCB

c. Provide flush or surface cabinet front as required with concealed trim clamps, hinged trim door-in-door construction with interior door containing a flush lock all keyed alike. Finish in manufacturer's standard gray enamel. Door-in-door hinged trim enclosure shall contain two quarter turn latches. (See detail at the end of this section.) University shall install the lock on the door-in-door exterior door.

d. Panelboards shall be fully rated. The use of series rated panelboards is prohibited.

2. Molded Case Circuit Breakers:

a. Provide full size bolt-on circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers listed as type SWD for applications where load will be switched at panelboard. Do not allow piggyback breakers. Breakers shall meet FSW-C-375.

3. Load Centers:

a. Load centers are prohibited.

B. Panelboard layout

1. Lighting and receptacle branch circuit breakers shall be minimum 20 ampere.

2. Provide minimum 25% future circuit spaces for total connected circuit breakers in panelboard.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards as follows:

1. Install panelboards plumb (and flush in finished areas).
2. Maximum height to top of panelboard shall be 6'-6".
3. Provide directory cards, typed, showing each branch circuit load with spares and space written neatly in erasable pencil.
4. For every three (3) unused spaces and/or three (3) spare breakers, stub one (1) 3/4" empty conduit out of flush mounted panelboards into accessible areas.
5. Where main breakers are required, they shall be bolted to the ends of the main busses. Back connected breakers and branch mounted breakers are prohibited.
6. Provide identification of panelboards per Section 16195 - Identification.
7. Panelboards which are installed in electrical equipment rooms shall not share the space with other systems such as piping, ductwork, telephone equipment, etc.

END OF SECTION 16470
SECTION 16501-LAMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fluorescent lamps.
2. HID lamps.
3. Incandescent lamps.

B. Related Sections:

1. Section 16502 - Ballasts and Accessories
2. Section 16510 - Lighting Fixtures
3. Section 16530 - Site Lighting

1.02 REFERENCES

A. Provide Underwriters Laboratories (UL) or Electrical Testing Laboratories (ETL) listed equipment, assemblies and materials.

1.03 SUBMITTALS

A. Provide submittals under the provisions of Section 16010 - Basic Electrical Requirements and 01300 - Submittals.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fluorescent Lamps:

1. General Electric
2. Phillips
3. OSRAM/Sylvania
4. Others only by approval of University

B. HID Lamps:

1. OSRAM/Sylvania
2. General Electric
3. Phillips
4. Others only by approval of University.

C. Incandescent Lamps:

1. General Electric
2. OSRAM/Sylvania
3. Phillips
4. Others only by approval of University

2.02 MATERIALS

A. General

1. All lamps used as lighting during construction for \( \geq 100 \) hours of use shall be replaced before final c.o. is issued. All lamps in new buildings shall have less than 100 hours of burn time or use.

B. Fluorescent Lamps

1. Fluorescent lamps shall be T-8 F32 energy saving with 3,500 degree K color only and with a color rendering index (CR1) of 73 or greater. All fluorescent lamps shall be low mercury type. Other lengths of lamps may be specified only by University written approval and if special conditions require them. Use compact fluorescent style lamps for down light applications where possible in lieu of incandescent for energy conservation and maintenance savings. Phillips F32T8/TL835 (T-8).

2. The use of T-8 lamps is required in all new luminaires. New T-12 lamps may only be used in existing to be reuse luminaires and with University approval.

3. Outdoor fluorescent lamps shall be high output, cool white, lengths as required.

C. HID Lamps:

1. Use super Metal Halide position orientated lamps for all exterior lighting.

2. For indoors, use color corrected metal halide lamps for applications where high light output and color rendering is required. Use low wattage color corrected metal halide lamps for lower ceiling architectural applications.

D. Incandescent Lamps:

1. Incandescent lamps shall not be used.

PART 3 EXECUTION

3.01 INSTALLATION

A. Replace non-functional lamps at time of final acceptance and provide 10% spare lamps.

END OF SECTION 16501
SECTION 16502-BALLASTS AND ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Ballasts and accessories for lighting equipment.

B. Related Sections:
   1. Section 16501 - Lamps
   2. Section 16510 - Lighting Fixtures
   3. Section 16530 - Site Lighting

1.02 REFERENCES

A. Provide only Underwriters Laboratories (UL) or Electrical Testing Laboratories (ETL) listed equipment, assemblies and materials.

B. Where appropriate, refer to current ANSI and NEMA Standards for material ratings.

C. All ballasts shall be UL and CBM listed.

1.03 SUBMITTALS

A. Provide submittals under the provisions of Section 16010 - Basic Electrical Requirements and 01300 - Submittals.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Ballasts in Order of Preference - Electronic
   1. Motorola
   2. Advance
   3. Magnetek
   4. Others only by approval of University

B. Ballasts in Order of Preference: Standard core and coil.
   1. Advance
2. Universal

3. Others only by approval of University

C. Use of Ballasts: Electronic ballasts shall be used in all new luminaries on a project, in compliance with manufacturers recommendations. Standard core and coil ballasts will only be allowed as replacements and on individual use by case basis with UCB permission only.

2.02 MATERIALS

A. Fluorescent Ballasts - Electronic Rapid Start Ballasts:

1. Provide electronic ballasts for all four foot rapid start T-8 (and T-12) lamps with voltage as indicated on the plans and luminaire schedule. The ballast shall deliver normal lamp life and must be interchangeable with electromagnetic ballasts. The light output shall not vary in response to an input voltage variance of less than 10% rated voltage. Drive output shall be greater than 25 kHz with lamp flicker less than 2%.

2. The ballast Total Harmonic Distortion shall be less than 10% with the third harmonic (180 Hz) distortion less than 8%.

3. The ballast shall have a crest factor of less than 1.7 and shall have transient protection which meets IEEE 587, category A (ANSI C62.41) requirements.

4. The ballast shall have a power factor of 0.98 or higher and shall have a ballast efficiency of 90% or higher.

5. The ballast shall be UL listed Class P and shall have a sound rating better than A.

6. The ballast electromagnetic interference shall be less than 54 dB from 450 kHz to 30 MHz (FCC CFR 47 Part 18 requirements).

7. The manufacturer shall provide a full five year warranty beginning at time of substantial completion. The manufacturer shall replace any and all failed ballasts within 48 hours of notification. The manufacturer shall provide the labor for warranty replacements, phone number and Fax number to report these outages and updates of those numbers.

8. The ballasts shall be Advance Mark V or Motorola. All other manufacturers shall request prior approval and supply test data from an independent testing laboratory to substantiate compliance with specifications.

B. Instant Start High Ballast Factor Ballasts:

1. The electronic ballast shall be provided with integral leads, color coded to ANSI standard C82.11 (latest version).

2. The “High Frequency” electronic ballast shall operate lamps at a frequency of 20 KHz or higher without visible flicker.

3. The electronic ballast’s input current shall have “Total Harmonic Distortion: (THD) of less than 20% when used with primary lamp.

4. The electronic ballast shall have a “Power Factor: greater than 98% when used with primary lamp.

5. The electronic ballast shall have “Lamp Current Crest Factor” of less than 1.7.

6. The electronic ballast shall support a sustained short to ground or open circuit of any output leads without damage to ballast.

7. The electronic ballast shall have an audible noise rating (Class A) or better.
8. Ballast shall meet the requirements of the Federal Communications Commission rules and regulations, part 18, for non-consumer equipment, ANSI C82.11 standards regarding harmonic distortion, ANSI C62.41 Cat. A for transient protection.
9. The electronic ballast shall be Underwriters Laboratories (UL) listed (Class P) and CSA Certified where applicable.
10. The electronic ballast shall carry a five year warranty.

C. Fluorescent Ballasts - Standard Ballast:

1. Magnetic ETL-CBM certified Premium Class P, energy saving, sound level “A” rated, high power factor with built-in auto resetting overload and overheat protective devices. Order of preference is Advance Mark III, Universal type SLH.

2. Low temperature ballasts shall be rated for minus 20 degree F for outdoor application.

C. HID Ballasts:

1. Constant wattage auto transformer type suitable for low temperature operation.

2.03 CONTROLS

A. Lighting Controllers - Photocells, time clocks, contactors, etc. shall be of normal proven products of a known manufacturer.

PART 3 EXECUTION

3.01 INSTALLATION

B. All projects which involve remodel of complete rooms or areas, electronic ballasts shall be used. New construction shall use rapid start ballasts. Where energy savings is a concern Instant start may be used with written permission. Low Ballast Factor instant start ballasts may only be used with written University permission.

END OF SECTION 16502
SECTION 16510
LUMINAIRES

SECTION 16510-LUMINAIRES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Interior luminaires and accessories.
   2. Outdoor architectural (building) luminaires.

B. Related Sections:

1. Section 16501 - Lamps
   2. Section 16502 - Ballasts and Accessories

1.02 REFERENCES

A. Provide only Underwriters Laboratories (UL) or Electrical Testing Laboratories (ETL) listed equipment, assemblies and materials.

B. Where appropriate, refer to current ANSI and NEMA Standards for material ratings.


1.03 SUBMITTALS

A. Provide submittals under the provisions of Section 16010 - Basic Electrical Requirements and 01300 - Submittals.

PART 2 PRODUCTS

2.01 EQUIPMENT

A. Fluorescent Luminaires:

1. Provide with hinged frames with latches, pre-wired with trim and accessories as required for ceiling system that luminaire is mounted into. Doors may be hinged from either side and shall be gasketed to prevent light leaks.

2. Recessed fluorescent fixtures to be equipped with 6' long flexible whip for connection to a junction box.

3. Acrylic lenses shall have a minimum 0.125 inch thickness.

B. Incandescent Luminaires shall not be used.

C. Exit Signs:

1. Light emitting diode (LED), low wattage type with long life, maintenance free battery require programmed discharge under load, self-testing and self-diagnostics. Green letters on white
SECTION 16510
LUMINAIRES

background. When used in a building with an emergency generator, batteries are not required.

2. Accepted Manufacturers:
   a. Exitronics, 500 Series
   b. Others only by approval by University

D. Egress/Emergency Lights. Self-testing (the unit shall perform battery tests in accordance with NFPA),
   self-diagnostic (the unit shall perform self diagnostics and indicate problems discovered via LED’s.)

   1. Dual Light Spectron
   2. Prescolite CVS
   3. Siltron Continuous Diagnostic
   4. Others by approval of University

E. HID Luminaires:

   1. Pre-wired with integral ballast. Where required by lamp failure, provide with protective lens to retain
      lamp particles in the event of non-passive lamp failure.
   2. Provide, where necessary, tungsten halogen lamp for instant light in the event of a momentary power
      outage.

PART 3 EXECUTION

3.01 INSTALLATION

   A. Provide independent support systems for all fixtures. All luminaires shall hang evenly and in straight rows.

   B. Outlet boxes which support lighting fixtures shall be required to have support from the building structure
      independent of conduit system and ceiling systems.

   C. Fluorescent fixtures shall be supported independently from the structural ceiling.

   D. All 3 and 4 lamp luminaires shall be dual switched.

   H. All interior recessed HID, and compact fluorescent luminaires shall have all wiring and ballasts be
      accessible through the ceiling luminaire opening. The angle of maximum candela from each interior
      fixture shall intersect opaque building interior surfaces and not exit building through windows

END OF SECTION 16510
SECTION 16720-FIRE ALARM AND DETECTION SYSTEMS

PART I. General

1.01 Reference

A. Related Sections
   1. Section 15300 – Fire Protection
   2. Section 15950 – Controls
   3. Division 16 - Electrical

B. References
   1. International Building Code
   2. International Fire Code
   3. National Electrical Code
   4. NFPA
   5. American National Standards Institute (ANSI)
   6. Design engineer and contractor shall use the UCB standard symbols
   7. ADA Guidelines

1.02 Quality Assurance

A. Manufacturer’s Qualifications: Firm regularly engages in the manufacture of fire alarm systems of types, sizes, and electrical characteristics compatible with the current campus systems, and whose products have been in satisfactory use in similar service for not less than 5 year

B. Installers Qualifications: Firm with at least 5 years of successful fire alarm systems installation experience. Installers shall have at least 2 years documented fire alarm installation experience and a minimum of a NICET II certification for Fire Alarm Systems

1.03 Codes and Standards:

A. Each and every item of the fire alarm system shall be new and listed as the product of a fire alarm system manufacturer under the appropriate category by Underwriters Laboratory, Inc. (UL) and shall bear the UL label on all devices

B. The complete installation shall conform to the applicable sections of NFPA especially NFPA 72 and the National Electrical Code

1.04 Summary

A. Proprietary Supervising Station: Class B–IDC, Class 4–SLC, Class B-NAC

B. Hardwire zones shall only be used with UCB permission and only for small systems

C. The fire alarm system and devices shall comply with ADA and UL requirements

D. At a minimum, provide manual pull stations at each building exit, adjacent to the FACP, and any stage manager consoles

E. Where feasible smoke detectors are to be provided as required by code and in electric and telecommunication/data rooms

F. The use of duct detectors shall be minimized where feasible, area detectors shall be used to accomplish the objective
G. Smoke detectors located in open areas should be used rather than duct-type detectors for the operation of any automatic smoke control system.

H. Stage Manager’s Console:
   1. A “Stage Manager’s Console” shall be installed in those areas open to the public for performances or special events where special effects could be used. Areas where special effects are used shall provide a means to disable detection during performances. All switches are to be identified and activate a system trouble upon activation of any switch.
   2. Any initiating devices that are disabled from the stage manager’s console shall cause a trouble at the FACP and activate a trouble lamp at the stage manager’s console.
   3. A pull station shall be located near the stage manager’s console.

I. Pre-Action systems shall operate in accordance with Section 15300.

J. Outside bell and strobe appliances shall track the main water flow device.

K. Elevators:
   1. Shunt trip shall be activated only from the FACP, not contacts on heat detectors.
   2. Where heat detectors perform elevator recall and shunt trip, smoke and heat detectors shall share the same time counter to activate the shunt trip. However, heat detector activation is required for shunt trip.
   3. Where required, the vent for the elevator shaft shall have a pneumatic damper where possible. Where allowed by code, the damper shall be normally closed (energize to open). The damper shall have a manual control located adjacent to the FACP and be keyed to the University standard. The damper activation shall be 24VDC powered from the fire alarm system.
   4. The 120VAC power to the elevator shunt trip shall be supervised.

L. A remote annunciator shall be required where the FACP is not readily accessible for Fire Department response in a building. At a minimum, annunciators shall have a control panel fully duplicating the functions of the FACP front panel.

M. The contractor shall install a remote reset station (provided by the Owner) adjacent to the fire alarm control panel and include the following:
   1. Common alarm and common trouble lamps.
   2. A single pole double throw remote silence switch. Upon activation, this switch will silence all notification appliances in the building. This switch shall be supervised by the FACP and keyed to the University standard.
   3. A single pole spring loaded remote reset switch that is supervised by the FACP and keyed to the University standard.

N. Door holders shall be non-supervised and release upon AC power loss.

O. Fan shutdown shall be hardwired through the fire alarm system.

1.05 Mass Notification System: In general, campus buildings shall be provided with Mass Notification System (MNS). Small buildings may not require MNS; examples include very small buildings such as pump houses, lawn equipment storage areas, single family houses on the Hill and similar places. The design team shall coordinate with the campus AHJ and determine whether the building under design needs to be provided with MNS. Only for buildings where it is determined and agreed that MNS is required and that it is combined with the fire detection and alarm system, all applicable paragraphs in this
section that refer to MNS shall apply. For buildings where it is determined and agreed that MNS is not required, none of the paragraphs that refer to MNS shall apply. Where the MNS is independent of the fire detection and alarm system, please refer to applicable codes and standards, instead of using this section.

A. New Buildings MNS:

1. All new buildings where a fire alarm control panel is required are to be provided with a combination Fire Alarm/Mass Notification System.
2. Speakers, instead of horns are to be used.
3. The system is to be installed in full compliance with the adopted edition of the National Fire Protection Association (NFPA) pamphlet no.72, National Fire Alarm Code.
4. The system is to be designed and installed such that announcements can be made for other emergencies on campus. The new or modified fire alarm control panel shall be capable of receiving audio inputs for announcements over the systems speakers. The panel shall be configured and programmed so that these inputs are a higher priority than a fire alarm (i.e., the audio inputs will override a current or pending fire alarm announcement).
5. The system is to be designed and installed such that campus emergency announcements can be made using a microphone at the fire alarm control panel and using microphones from two remote campus buildings, e.g., possibly University of Colorado Police Department (CUPD) and the Service Center.
6. The combination systems need to be tested and maintained by CU personnel in accordance with the testing and maintenance procedures and frequencies required by NFPA-72. If in-house maintenance and testing expertise are not available, outside agencies need to be hired to ensure compliance with testing and maintenance requirements.
7. Currently, CU Dispatch can use a dial-in system to access the public address system of several campus buildings. As an intermediate measure, all new systems should have this feature, allowing CUPD dispatch to communicate with the occupants via a dial-in connection. However, in the long term, the objective is to provide CUPD dispatch with a control panel which would allow the CUPD dispatch to readily select any number of buildings (that have a Public Address system) for announcements. The details of this long term plan will be established by an outside consultant.
8. Speakers shall be provided in compliance with the Emergency Voice/Alarm Communications system from NFPA 72.
9. For emergency voice/alarm communication systems, contractor shall perform intelligibility testing for the building. All large and/or complicated spaces and a random sample of remaining areas shall be tested. Testing shall be performed in accordance with Annex B, Clause B1, of IEC 60849. The system is to exceed the equivalent of a common intelligibility scale (CIS) score of 0.70. Alternatively, the use of subject-based tests methods as described in ANSI S3.2, Method for Measuring the Intelligibility of Speech Over Communication Systems, may be used if pre-approved by the University and detail testing procedures are provided.
10. Interior emergency voice/alarm systems shall have speakers installed in accordance with NFPA 72. Speakers are to be provided with integral strobe visual alarm where appropriate. Mounting of all devices shall comply with ADA requirements. Speakers shall be designed and installed to provide voice intelligibility throughout all areas of the
building. Areas where voice intelligibility cannot be provided due to high ambient noise levels (e.g., mechanical spaces) shall be separately evaluated by the Engineer to determine appropriate design requirements. Engineers are encouraged to use an acoustical program (e.g., EASE from Renkus-Heinz or Modeler from Bose) to determine speaker layout for large and/or complicated spaces. Provide Wheelock E70/E90 or ET70/ET90 series speakers or as approved by the University.

B. Existing Buildings MNS: The fire alarm system construction activities in existing buildings fall under three categories as explained below:

1. Fire alarm system replacements: The new system is to comply with the requirements for new buildings (see section #3 above).

2. Fire alarm major upgrades: If feasible, the upgraded system is to comply with the requirements for new buildings (see section #3 above). Feasibility is to be determined by the project administrator and FLS. At a minimum, all new Fire Alarm Control Panels (FACP) and devices added are required to be compatible with a Combination Fire Alarm/Public Address System so that the system is more readily convertible to a Combination system during future upgrades.

3. Fire alarm system minor upgrades: Compliance with new building requirements, listed under item I above, is not required. If feasible, all new panels and devices added are to be compatible with a combination Fire Alarm/Public Address System so that the system will be readily convertible to a Combination system during future upgrades.

1.05 Submittals

A. Shop drawings must be submitted within 30 days after award of contract and shall include the following:

1. Locations of alarm initiating and notification appliances
2. Alarm control equipment
3. Annunciation
4. One line diagram for the complete system including device addresses and room numbers
5. Power connections
6. Battery calculations
7. Network connections
8. Voltage drop calculations
9. Manufacturer’s model numbers, and listing information for equipment, devices and material
10. The interface of fire control functions and sequence of operations
11. UCB wiring installation guide
12. Graphic Command Center (GCC) graphic screens

B. Operations and maintenance manuals (O&M’s) shall be submitted within 30 days of the final accepted fire alarm test and shall contain:

1. Four sets of complete as-built drawing the same size as the original drawings and two CAD disk containing all items of “A” above corrected to include all shop drawing comments and reflect actual space installation. The CAD drawings shall be based on campus CAD standards available from the Facilities Management CAD office.

2. Complete schematic and interconnection wiring diagrams, internal and external, including junction box wiring with all terminal strip and wire numbers.
3. Parts list including complete parts price list and recommended spare parts list

1.06 Delivery, Storage, and Handling
A. Store fire alarm equipment in a clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage
B. Do not install damaged equipment or components; replace with new

PART II. Products

2.01 Manufacture
A. All fire alarm equipment shall be supplied by one representative. All equipment and wiring configurations shall be reviewed and approved by the AHJ and the Owner. Equipment shall be:
   1. Simplex
B. All fire alarm equipment shall be compatible with the campus fire alarm systems and networks.
C. The manufacturer’s representative and service agency supplying the equipment must have factory authorized 24 hour on-call service departments and a complete stock of spare parts. Agencies must be located within a 50-mile radius of the campus. Response time must be guaranteed within 24 hours of notification.

2.02 Addressable Communication
A. The fire alarm system shall provide communication with individual initiating and control devices, annunciated at the FACP
B. All addressable devices shall have the capability of being individually disabled and enabled by the FACP
C. Fire alarm systems that require factory reprogramming to add or delete devices are not acceptable
D. The use of jumpers to set the address shall not be acceptable
E. Device identification that rely on electrical position along the communication lines and do not use unique addresses shall not be acceptable

2.03 Fire System Devices
A. Manual Pull Stations:
   1. Manual, non-coded, single action flush or surface mounted as specified
   2. An indication of operation shall be visible until the device has been manually reset
   3. Problem areas such as spaces for theatrical, sporting, or seminar events, etc. shall utilize dual action break glass type pull station. In dormitories, and other areas susceptible to nuisance alarms, provide a clear shielded enclosure with a battery operated sounder
B. Heat Sensors:
   1. All heat sensors shall be of the addressable type unless environmental conditions prohibit their use. If non restorable detectors are used, an addressable module shall be located in an area not subject to the adverse environment
2. Rate of rise detectors will be used with UCB permission only. Fire alarm reset shall be required to restore a rate of rise detector to normal

C. Smoke Detectors:
   1. Smoke detectors shall be analog and capable of alarm verification
   2. Smoke detectors shall have environmental compensation and provide a trouble at the FACP when the sensor’s value reaches a predetermined value
   3. Smoke detector/control unit shall be arranged so that the detector causes a signal at the control unit when its sensitivity is outside its listed range

D. Duct detectors shall have duct sampling tubes, remote indicator and test switch. Units shall be able to reset at the FACP

E. Horns used in sensitive animal research areas shall be Silentone MKII or AHJ approved equal

F. All signaling devices shall be simplex or wheelock

PART III. Execution

3.01 Identification
   A. All new and reused junction boxes shall be painted red and labeled “Fire Alarm”
   B. All conductors shall be numbered and their numbers shall correspond to the terminal block numbering they are connected to
   C. Device labeling:
      1. All initiating and notification devices shall be labeled with the appropriate circuit number(s)
      2. Labels shall be 3/8” high lettering, black on clear background

3.02 Installation of Basic Wiring Systems
   A. All cable and wiring shall be installed in conduit by a Colorado licensed electrician and in compliance with Division 16
   B. All wiring shall be in conduit
   C. Provide basic wiring materials that comply with Division 16.
      1. Use only copper conductors
      2. Provide conductors which are UL listed for installation and location, and approved for fire alarm use
      3. Wire color and size shall be per the University Standards, see attachment “Installation Guidelines”. If inconsistent with the existing building fire alarm wiring, the contractor shall match the existing wire colors and note it on the as-built drawings
   D. Install wire and cables in accordance with the manufacturer’s requirements and in compliance to NEC.
   E. All junction boxes 8"x 8” or larger shall be provided with numbered terminal strips with all wires numbered and landed on corresponding terminals. One conductor per terminal
   F. Only one extension ring is allowed on a 4”x 4” box
   G. Provide a ¼” conduit from the FACP to the building main telephone room for the campus fire alarm network connection. Run 4 multimode fiber strands or 4
copper conductors between the FACP and the fire alarm network. Verify the connection type with UCB personnel prior to installation.

H. All riser conduits shall be a minimum 1" to 8"x8" minimum junction boxes
I. Contractor shall not pull wire through existing raceways with live circuits without prior CU approval

3.03 Installation of Fire Alarm Systems
A. All outside bells, horns, and strobes shall be installed a minimum of 10'0" above finished grade
B. All outside audible appliances shall have an audible level no less than 90db at 10'
C. All conduit and boxes within 6'0" of tamper and water flow switches shall be watertight
D. All Remote test switches shall be located in common areas at a height of 7'0" above finished floor

3.04 Fire Alarm Network
A. Graphic Command Center
   1. All additions and/or changes to the fire alarm system shall be updated at the supervising station and all appropriate (as determined by Facilities Operations Fire Systems Group) graphic command centers to include graphic screens
   2. All new or updated FACP’s shall use fiber optics to tie into the campus fire alarm network

3.05 Field Quality Control
A. Make all connection to the control equipment under UCB personnel or manufacturer’s supervision
B. Notify the University Fire Systems Group a minimum of 2 days prior to any interruption or modification of any existing fire alarm system for scheduling of work (303-492-0791)
C. Final Acceptance Testing:
   1. Before the final test, the contractor shall perform a complete system check with the manufacturer’s representative present. This test shall be completed without the involvement of the Owner. The test of the fire alarm system, initiating devices, notification appliances, and all functions of the FACP shall comply with NFPA 72. This "preliminary" test shall be documented as to what was tested and the test procedures used. This test documentation, NFPA 72 Record of Completion, and the attached Fire Alarm Application for Final Acceptance Test shall be submitted to the Owner prior to scheduling a final test
   2. As a final test, the contractor and a manufacturer’s representative shall demonstrate to the design engineer and the Owner’s representative that the system is in full operation status. This demonstration shall include testing 100% of the devices and/or the systems as directed by the design engineer and witnessed by the Owner’s representative. The contractor shall furnish all test equipment necessary to complete the testing. In cases where a system was remodeled or added to, all new
devices shall be 100% tested and a representative quantity of existing devices, as determined by the Owner’s representative, shall be re-tested to ensure proper operation of the system.

3.06 Warranty

A. The contractor shall guarantee all equipment and wiring free from inherent mechanical and electrical defects for a period of 1 year from the date of acceptance as set forth in the general conditions

3.07 Operating and Maintenance Instruction

A. Conduct instruction to the Owner’s representative on all normal maintenance and trouble shooting procedures down to circuit board level of equipment included in contract (minimum of eight hours per new system, one to four hours as required for remodeled systems)

B. For major projects, when needed by the Fire Systems Group, provide one week, minimum forty hours, of factory training (component and programming) for University technicians. Training may be either at the factory or in the Denver/Boulder area. Training shall include transportation, lodging, and one meal a day for one technician

C. Failure to comply with all contractual obligations resulting in costs incurred by the University shall result in those costs being transferred to the appropriate contractor for payment

D. Contractor shall be financially responsible for all fees to the University by the Boulder Fire Department, and all lost research due to false alarms

3.08 Fire Watch and Shut Down Requirements

A. Fire Alarm Shut Down

1. Except for replacement of control equipment, at no time during construction should the entire fire alarm system be disabled where the notification devices are not functioning

2. If the fire alarm system is out of service, fire watches shall be posted in accordance with UCB procedures. See requirements at http://fm.colorado.edu/firesafety/constructionpolicies.html

3.09 Painting and Patching

A. Contractor shall paint exposed conduit to match adjacent surfaces. All surfaces or finishes damaged as a result of work shall be properly patched, painted, and/or repaired by trained craftmen of the trade involved
## Installation Guidelines

### ****ALL WIRE IS SOLID COPPER****

<table>
<thead>
<tr>
<th>CIRCUIT TYPE</th>
<th>COLORS</th>
<th>SIZE</th>
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</thead>
<tbody>
<tr>
<td>FIRE ALARM ZONES</td>
<td>RED - BLACK -</td>
<td>14 THHN</td>
</tr>
<tr>
<td>MAPNET</td>
<td>RED - BLACK -</td>
<td>18 TWISTED SHIELDED</td>
</tr>
<tr>
<td>COMMUNICATION LINE (MINIPLEX OR LCD)</td>
<td>RED - BLACK -</td>
<td>18 TWISTED SHIELDED</td>
</tr>
<tr>
<td>AUDIO RISER (VERTICAL RUNS)</td>
<td>RED - BLACK -</td>
<td>12 TWISTED SHIELDED</td>
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<tr>
<td>HORNS</td>
<td>RED + BLACK -</td>
<td>#14 THHN JACKETED CABLE (2 CONDUCTOR)</td>
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<tr>
<td>STROBES (VISUALS)</td>
<td>YELLOW - BROWN -</td>
<td>14 THHN</td>
</tr>
<tr>
<td>SPEAKERS (HORIZONTAL RUNS)</td>
<td>RED - BLACK -</td>
<td>14 TWISTED SHIELDED</td>
</tr>
<tr>
<td>12 VOLT DC POWER</td>
<td>WHITE - BLACK -</td>
<td>14 THHN</td>
</tr>
<tr>
<td>DOOR HOLDERS (24 VOLTS DC)</td>
<td>BLUE - WHITE -</td>
<td>14 THHN</td>
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<tr>
<td>REMOTE TEST SWITCHES</td>
<td>WHITE WHITE</td>
<td>16 THHN</td>
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<tr>
<td>REMOTE LIGHTS</td>
<td>RED - BLACK -</td>
<td>16 THHN</td>
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<tr>
<td>FAN CONTROLS</td>
<td>GRAY (N-O), PINK (N+O), ORANGE (COMMON)</td>
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<tr>
<td>DAMPER CONTROLS</td>
<td>SAME AS FANS</td>
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<td>REMOTE FIRE FIGHTERS SIGNAL SILENCE</td>
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<td>REMOTE FIRE FIGHTERS TROUBLE LIGHT</td>
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<td>REMOTE FIRE FIGHTERS ALARM LIGHT</td>
<td>RED</td>
<td>#18</td>
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<tr>
<td>REMOTE FIRE FIGHTER LAMP COMMON</td>
<td>BLACK</td>
<td>#18</td>
</tr>
<tr>
<td>FIRE ALARM NETWORK CONNECTIONS (2 CABLES REQUIRED)</td>
<td>RED AND BLACK</td>
<td>16 TWISTED SHIELDED</td>
</tr>
</tbody>
</table>

### Elevator Recall

| ELEVATOR RECALL PRIMARY         | PURPLE - PURPLE         | 16 THHN               |
| ELEVATOR RECALL ALTERNATE      | SILVER - SILVER        | 16 THHN               |
| SHUNT TRIP (#12 CONDUCTORS FOR 120 VAC) | WHITE - BLACK | 14 THHN |

*All wiring sizes indicated are minimum*
SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
2. Excavating and backfilling for buildings and structures.
4. Subbase course and base course for asphalt paving.
5. Subsurface drainage backfill for walls and trenches.

B. Related Sections:

1. Division 01 Section "Construction Progress Documentation, Photographic Documentation" for recording preexcavation and earth moving progress.
2. Division 01 Section "Temporary Facilities and Controls" for temporary controls, utilities, and support facilities; also for temporary site fencing if not in another Section.
3. Division 03 Section "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
4. Divisions 21, 22, 23, 26, 27, 28, and 33 Sections for installing underground mechanical and electrical utilities and buried mechanical and electrical structures.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Division 01 Section "Unit Prices."

B. Quantity allowances for earth moving are included in Division 01 Section "Allowances."

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.

1. 24 inches (600 mm) outside of concrete forms other than at footings.
2. 12 inches (300 mm) outside of concrete forms at footings.
3. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
5. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
6. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.
1.4 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
   1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch (1065-mm) wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom; measured according to SAE J-1179.
   2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp (172-kW) flywheel power and developing a minimum of 47,992-lbf (213.3-kN) breakout force with a general-purpose bare bucket; measured according to SAE J-732.

I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.5 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: 12 by 12 inches (300 by 300 mm).
2. Warning Tape: 12 inches (300 mm) long; of each color.

C. Qualification Data: For qualified testing agency.

D. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 698, ASTM D 1557.

E. Blasting plan: Blasting will not be allowed.

F. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.6 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

B. Preexcavation Conference: Conduct conference at Project site.

1.7 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Division 01 Section "Temporary Facilities and Controls," are in place.

E. Do not commence earth moving operations until plant-protection measures specified in Division 01 Section "Temporary Tree and Plant Protection" are in place.

F. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 1 1/2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: All other soils.

D. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch (37.5-mm) sieve and not more than 12 percent passing a No. 200 (0.075-mm) sieve.

F. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

G. Sand: ASTM C 33; fine aggregate.

H. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.
2.2 GEOTEXTILES

A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf (1100 N); ASTM D 4632.
3. Sewn Seam Strength: 222 lbf (990 N); ASTM D 4632.
4. Tear Strength: 90 lbf (400 N); ASTM D 4533.
5. Puncture Strength: 90 lbf (400 N); ASTM D 4833.
6. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.3 CONTROLLED LOW-STRENGTH MATERIAL

A. Controlled Low-Strength Material: Self-compacting, low-density, flowable concrete material produced from the following:

1. Portland Cement: ASTM C 150, Type I Type II or Type III.
2. Fly Ash: ASTM C 618, Class C or F.
5. Water: ASTM C 94/C 94M.

2.4 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.
PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.3 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
   a. 12 inches (300 mm) outside of concrete forms at footings.
   b. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
   c. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
   d. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
   e. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.

   a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the dimensions per Section 3.4.

3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pull roots.
2. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

C. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pull roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
3. Cut and protect roots according to requirements in Division 01 Section "Temporary Tree and Plant Protection."

3.7 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices, changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete."

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Place and compact initial backfill of satisfactory soil, free of particles larger than 1 inch (25 mm) in any dimension final subgrade.

F. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches (300 mm) over the pipe or conduit. Coordinate backfilling with utilities testing.

G. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.

H. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 8 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 8 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.
4. For utility trenches, compact each layer of initial and final backfill soil material at 95 percent.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. Pavements: Per CDOT Road and Bridge Construction Standards.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.16 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Shape and base course to required crown elevations and cross-slope grades.
4. Place and base course or less in compacted thickness in a single layer.
5. Place and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
6. Compact and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.17 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length, but no fewer than two tests.

3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length, but no fewer than two tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000