PROJECT MANUAL

INCLUDING CONSTRUCTION SPECIFICATIONS

for

V-S034, TERMINAL C LST LEVEL 1 DUMPSTER PAD ENCLOSURE (D/B)

ORLANDO INTERNATIONAL AIRPORT

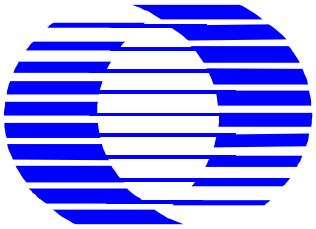
Orlando, Florida 32827

CONTRACT DOCUMENTS

Issue Date

February 23, 2023

VOLUME 2 OF 6



GREATER ORLANDO AVIATION AUTHORITY

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REVISIONS:

Rev. # column represents the sequence in which the specifications, whole or in part, were issued.
BOLD and Underlined are new, revised, or edited sections in this issue.
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SECTION 02 41 19 - SELECTIVE DEMOLITION

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. 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 Requirements:

1. Section 01 10 00 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 01 73 29 “Cutting and Patching" for cutting and patching procedures.
3. Section 01 74 19 “LEED v4 Construction Waste Management and Disposal” for demolition waste disposal.

1.3 DEFINITIONS

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

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.

D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.

E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.5 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.

3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.6 INFORMATIONAL SUBMITTALS

A. Engineering Survey: Submit engineering survey of condition of building.

B. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection and for dust control. Indicate proposed locations and construction of barriers.

C. 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 on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

D. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 01 32 33 "Photographic Documentation." Submit before Work begins.

E. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

1.7 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

1.8 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

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

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.

1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

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.

1.9 WARRANTY

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

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

1.10 COORDINATION

A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. Standards: Comply with ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Engage a professional engineer to perform an engineering survey of 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 building demolition operations.

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

D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.

E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.

1. Comply with requirements specified in Section 01 32 33 "Photographic Documentation."
2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off 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. Arrange to shut off utilities with utility companies.
3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    c. Equipment to Be Removed: Disconnect and cap services and remove equipment.

d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 PROTECTION

A. Temporary Protection: 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 Section 01 50 00 "Temporary Facilities and Controls."

B. Temporary Shoring: Design, 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.

C. Remove temporary barricades and protections where hazards no longer exist.

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. 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 portable fire-suppression devices during flame-cutting operations.
5. Maintain fire watch during and for at least six hours after flame-cutting operations.
6. Maintain adequate ventilation when using cutting torches.
7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
10. Dispose of demolished items and materials promptly. Comply with requirements in Section 01 74 19 “LEED v4 Construction Waste Management and Disposal”.

B. 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.

~~C. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic. In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling" as specified in Section 02 42 96 "Historic Removal and Dismantling."~~

~~D.~~C. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

~~E.~~D. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
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.

~~F.~~E. 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 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. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

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

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

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and recycle or dispose of them according to Section 01 74 19 “LEED v4 Construction Waste Management and Disposal”.

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.
4. Comply with requirements specified in Section 01 74 19017419 “LEED v4 Construction Waste Management and Disposal”.

B. Burning: Do not burn demolished materials.

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.

B. Refer to Section 01 74 23 “Final Cleaning” for additional cleaning requirements.

END OF SECTION 02 41 19

SECTION 03 15 13 - WATERSTOPS

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 provides for an expanding hydrophilic waterstop as specified herein, illustrated on project drawings, or as required to complete the work to comply with waterproofing warranty requirements.

B. System Description:

1. Waterstop Strip: A non-Bentonite hydrophilic waterstop with a minimum swell as per Section 2.02
2. Accessories for complete waterstop application

C. Related Requirements:

1. Section 03 30 00 “Cast-In-Place Concrete”
2. Section 07 13 26 “Self-Adhering Sheet Waterproofing”

1.3 SUBMITTALS

A. Product Data: Submit manufacturer’s product data, installation instructions, use limitations and recommendations.

B. Shop drawings showing locations and extent of waterstop.

C. Written documentation demonstrating Installers qualifications under the "Quality Assurance" article including reference projects of a similar scope.

D. Samples: Submit representative sample of actual product.

E. Warranty: Submit a sample warranty identifying the terms and conditions stated in Section 1.7.

1.4 QUALITY ASSURANCE

A. Manufacturer: Waterstop systems shall be manufactured and marketed by a firm with a minimum of 20 years’ experience in the production and sales of building materials. Manufacturers proposed for use, but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past five years.

B. Installer Qualifications: A firm which has at least three (3) years experience in work for the type required by this section.

C. Material: Waterstop shall be by single source manufacturer and shall be specially engineered to be a swellable and conformable polyurethane/butyl blended rubber free of sodium bentonite that expands when in contact with water.

D. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of surface preparation, installation procedures, special details, inspection, protection, and repair procedures.

E. Concrete: Concrete shall be normal weight structural concrete and provide a minimum cover of 3” around waterstop.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in the original, unopened containers with seals unbroken, labeled with the manufacturer's name, product brand name and type, date of manufacture and directions for storage and use.

B. Store and handle materials in strict compliance with manufacturer’s instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

1. Store material off ground and keep dry.
2. Provide cover for material to protect top and sides.

C. Sequence deliveries to avoid delays, but minimize on-site storage.

1.6 PROJECT CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.

B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive waterstop.

C. Do not allow waste products (i.e. petroleum, grease, oil, solvents, vegetable or mineral oil, animal fat, acids, etc.) to come into contact with the waterstop. Any exposure to foreign materials or chemical discharges must be presented to the Membrane Manufacturer to determine the impact on the waterstop performance.

D. Maintain environmental conditions within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

E. Construction Manager shall assure adequate protection during and after the application of the waterstop.

1.7 WARRANTY

A. Provide written watertight warranty from the manufacturer that includes both labor and material for the below grade walls and the under slab waterproofing. The warranty to be issued by the membrane manufacturer upon completion of the work.

1. Warranty Period: Five years from date of Substantial Completion.
2. Refer to Section 07 13 26 “Self-Adhering Sheet Waterproofing” for additional warranty information.

PART 2 - PRODUCTS

2.1 WATERSTOPS

A. Basis-of-Design Product: Subject to compliance with requirements, provide GCP Applied Technologies, Inc., Grace Adcor or comparable product by one of the following manufacturers.

1. Henry Company
2. JP Specialties, Inc.
3. Sika Corporation
4.

2.2 MATERIALS

1. Hydrophilic Waterstop Strip: swellable, conformable polyurethane/butyl blended rubber based material free of sodium bentonite.
2. Waterstop Physical Properties:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Examine conditions of substrates and other conditions under which this work is to be performed and notify the Architect, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 PREPARATION OF SUBSTRATES

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Do not install waterstop onto any substrates with standing water.

3.3 INSTALLATION

A. Refer to manufacturer’s literature for recommendations on installation, including but not limited to, the following:

1. Construction Joint:
    a. On irregular concrete faces, apply a ½ in. Adhesive as bedding.
    b. Secure waterstop using masonry nails 1½ in. - 2 in. (40 mm – 50 mm) long with a washer ¾ in. (20 mm) in diameter. Hilti EM6-20-12 FP8 shot fired fixings with ¼ in. (6 mm) nuts and ¾ in. (20 mm) diameter washers may also be used. Fixings should be spaced at a maximum of 12 in. (300 mm) centers with a minimum spacing that ensures proper contact to substrate.
    c. waterstop joints should overlap a minimum of 4 in. (100 mm), ensuring full contact between jointed pieces.
    d. waterstops can be bent around corners; however on complex geometry use manufacturer’s approved Adhesive to fill any gaps.
    e. Any damaged sections should be removed and repaired with a new section of waterstop.
    f. Keep waterstop dry prior to pouring concrete.
2. Pipe Penetration:
    a. Waterstop Adhesive must be applied to dry substrates only. Apply by brush to the substrate. Wait until surface is dry to touch, and then press waterstop firmly into place.
    b. Waterstop joints should overlap a minimum of 4 in. (100 mm), ensuring full contact between jointed pieces.
    c. Keep waterstop dry prior to pouring concrete.

3.4 CLEANING AND PROTECTION

A. Protect membrane in accordance with manufacturer's recommendations until placement of concrete.

B. Inspect for damage just prior to placement of concrete and make repairs in accordance with manufacturer's recommendations.

END OF SECTION 03 15 13

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

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. All cast-in-place concrete, incidental construction, and miscellaneous structural concrete items, in accordance with the Contract Documents.
2. Providing services of testing laboratory to design concrete mixes.
3. Furnishing, erecting, and removing forms, falsework, shoring, and bracing required for work under this Section.
4. Furnishing, fabricating, and placing reinforcing bars and wire mesh reinforcing.
5. Furnishing and placing joint materials.
6. Furnishing and placing inserts required to be installed under this Specification Section and other Specification Sections.
7. Finishing, saw cutting, and concrete repairs.
8. Curing concrete.
9. Cleaning concrete.

B. Related Work Specified Elsewhere:

1. Section 05 12 00 “Structural Steel”
2. Section 31 20 00 "Earth Moving for Building Slabs" for drainage fill under slabs-on-grade.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

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. Special concrete finish Subcontractor.

2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, hot-weather concreting procedures, curing procedures, construction contraction and isolation joints,

forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.4 ACTION SUBMITTALS

A. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Regional/Local Multiplier Compliance
   b. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Corporate Sustainability Reporting (CSR’s)

B. General: Submit the following in accordance with the Contract Provisions:

1. Product Data: Submit product data for proprietary materials and items, including reinforcement, forming accessories, admixtures, patching compounds, waterstops, joint systems, curing compounds, vapor retarders and others as requested by the Architect.
2. Include descriptive data, catalog cuts, laboratory test reports, and any other information necessary to show acceptable materials and confirm Contract compliance.
3. Annotate data to show specific products to be used.

C. Coordination Drawings: Submit original coordination drawings that identify the type and location of embeds, penetrations or other provisions required to execute the work of structural, architectural, plumbing, electrical or other trades. These items shall be located both by plan dimension and proposed elevation. Do not finalize shop drawings for reinforcement or formwork until the coordination drawings have been approved.

D. Shop Drawings for Reinforcement: Submit original shop drawings for fabrication, bending, and placement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

1. Comply with ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures".
2. Show bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement.

E. Shop Drawings for Formwork: Submit shop drawings for fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joints or reveals, location and pattern of form tie placement, and other items that visually affect exposed concrete.

1. Submit complete and accurate shop drawings as required to adequately illustrate and control the finished work. Show all dimensions, kind, type, and quality of all materials, applicable specification references, and all other information as may

be necessary to detail finished construction of the work covered. Reproductions of the Contract Drawings are not acceptable as shop drawings.

2. Shop drawings shall show walls in elevation and cross-section. Shop drawings shall show clear cover over reinforcing bars and interface with all columns, walls and beam/slab reinforcement.
3. Shop drawings shall show locations of all embedded items.
4. Submit details indicating contraction joints and joint sealers.
5. Indicate materials utilized for sealing formwork joints and as a form release agent for coordination of subsequent coverings.

F. Setting Drawings: Provide setting drawings and templates showing the location of all anchorage items that are to be cast into concrete.

G. Concrete Mix Design Data: Not less than four weeks prior to the first concrete placement submit concrete mix design data to the Architect for review and approval. Mix designs shall be calculated and certified by the testing laboratory, and shall indicate the weight of each ingredient of the mixture, aggregate gradation, slump, air content, water-cement ratio and 7 day and 28-day compressive strength test results. Include a complete list of materials including admixtures and applicable reference specifications.

H. Test and Inspection Reports: Provide reports as necessary to ensure that the tests and inspections specified have been executed.

1.5 INFORMATIONAL SUBMITTALS

A. Certificates of Compliance: Submit manufacturer's certificates of compliance for the following materials showing that the named material conforms to the requirements of the Contract Documents. The manufacturer's certifications shall name the appropriate materials, the publication or publications specified as controlling the quality of that item, and shall state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificate of compliance, and having legal authority to bind the manufacturer. Furnishing certificates of compliance shall not provide relief of responsibility for providing materials that conform to the requirements of the Contract Documents.

1. Aggregates.
2. Admixtures.
3. Reinforcement
4. Cement.

1.6 QUALITY ASSURANCE

A. Testing Service and Quality Control Testing During Construction: The **Contractor** will retain the services of a testing services to provide, plant testing, field sampling, in-place testing, and quality control testing required under the Contract Documents.

B. The following requirements are intended to supplement GOAA's speciation 01 4529 Structural Testing and Inspection. Where conflict exist specification 01 4529 Structural Testing and Inspection shall govern.

C. Materials' Laboratories: All mix design testing and material evaluation tests of the work specified in this Section shall be performed by independent, commercial testing laboratories employed under this Section and accepted by the Architect. The basis of acceptance includes the following:

1. Laboratories performing work in connection with concrete materials shall conform to the requirements of ASTM E 329 and ASTM E 699.
2. Provide proof that the laboratory satisfies the requirements of the American Council of Independent Testing Laboratories' Recommended Requirements for Independent Laboratory Qualification.

D. Control of Material Uniformity: All cast-in-place concrete which is exposed to view shall not have the respective sources, brands, types, and/or grades of fine aggregate (sand), coarse aggregate, cement, and admixtures changed or switched after acceptance design mixes. Obtain concrete materials from one manufacturer for each cementitious component and from one source and producer for each aggregate component. Procure and store on site sufficient quantities of materials to cover all exposed concrete work to ensure color and texture match. If any doubt exists as to the timely availability of any material from designated sources, the Engineer shall be immediately informed, in writing, of the potential problem and of the action to be taken to guaranty the availability of such uniformly sourced materials.

1. Cement and aggregate used for all surfaces exposed to public view shall be obtained from a single source and in such quantities to ensure sufficient materials are available to complete the entire project. Uniformity of color and texture for all concrete exposed to public view is a mandatory project requirement.
2. Changes in the sources, types of materials, and/or proportions of materials shall not be made during construction until accepted and until the requirements for verification as specified herein have been satisfied and accepted by the Architect.
3. Sampling of materials shall be performed in accordance with the standard methods of ACI, AASHTO, and ASTM.
4. Materials shall be inspected at the original or intermediate source of supply. Inspection shall not diminish the responsibility to furnish materials that conform to the Specifications. The laboratory representative shall have ready access to all parts of any processing plant furnishing material for the Project. Access for sampling and inspecting materials or plant equipment shall include secure, sturdy platforms conforming to local, state, and federal safety regulations.

E. Applicable Publications: The following publications listed below form a part of this Specification to the extent referenced.

1. American Association of State Highway and Transportation Officials (AASHTO) Publications:

M 182 Burlap Cloth Made From Jute or Kenaf
T 103 Soundness of Aggregates by Freezing and Thawing

2. American Concrete Institute (ACI) Publications:

207.1R Guide to Mass Concrete
211.1 Selecting Proportions for Normal, Heavy Weight, and Mass Concrete
211.2 Selecting Proportions for Structural Lightweight Concrete
213R Guide for Structural Lightweight Aggregate Concrete
214 Recommended Practice for Evaluation of Strength Test Results of Concrete
301 Specifications for Structural Concrete for Buildings
302.1R Guide for Concrete Floor and Slab Construction
304R Guide for Measuring, Mixing, Transporting and Placing Concrete
304.2R Placing Concrete by Pumping Methods
305R Hot Weather Concreting
308 Standard Practice for Curing Concrete
309R Guide for Consolidation of Concrete
315 Manual of Standard Practice for Detailing Reinforced Concrete Structures
318 Building Code Requirements for Reinforced Concrete
347R Guide to Formwork for Concrete

3. American Society for Testing and Materials (ASTM) Publications:

A 36 Structural Steel
A 185 Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement
A 307 Carbon Steel Bolts and Studs
A 563 Carbon and Alloy Steel Nuts
A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A 775 Epoxy Coated Reinforcing Bars
B 633 Electrodeposited Coatings of Zinc on Iron and Steel
C 31 Making and Curing Concrete Test Specimens in the Field
C 33 Concrete Aggregates
C 39 Compressive Strength of Cylindrical Concrete Specimens
C 42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
C 78 Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
C 88 Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C 94 Ready-Mixed Concrete
C 143 Slump of Portland Cement Concrete
C 150 Portland Cement
C 171 Sheet Materials for Curing Concrete
C 172 Sampling Freshly Mixed Concrete
C 173 Air Content of Freshly Mixed Concrete by the Volumetric Method
C 192 Making and Curing Concrete Test Specimen in the Laboratory
C 227 Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations
C 231 Air Content of Freshly Mixed Concrete by the Pressure Method

C 260 Air-Entraining Admixtures for Concrete
C 494 Chemical Admixtures for Concrete
C 496 Splitting Tensile Strength of Cylindrical Concrete Specimens
C 567 Unit Weight of Structural Lightweight Concrete
C 641 Test Method for Staining Materials in Lightweight Concrete Aggregates
C 881 Epoxy-Resin-Base Bonding Systems for Concrete
D 1751 Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
D 1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
E 154 Methods of Testing Materials for Use as Vapor Barriers Under Concrete Slabs and as Ground Cover in Crawl Spaces
E 329 Practice for Use in the Evaluation of Testing and Inspection Agencies as Used in Construction
E 699 Practice for Criteria for Evaluation of Agencies Involved in Testing, Quality Assurance and Evaluation Building Components in Accordance with the Test Methods Promulgated by ASTM Committee E-6

4. American Welding Society (AWS) Publications:

   a. D1.1 Structural Welding Code--Steel
   b. D1.4 Structural Welding Code--Reinforcing Steel

5. Concrete Reinforcing Steel Institute (CRSI) Publication:

F. Placing Reinforcing Bars

1. Federal Specification (FS) Publication:

   FF-S-325 Shield Expansion, Nail Expansion, and Nail, Drive Screw (Devices Anchoring, Masonry)

2. U.S. Army Corps of Engineers (COE) Waterways Experiment Station Publications:

   CRD-C-572 Corps of Engineers Specification for Polyvinyl Waterstops
   CRD-C-621 Handbook for Concrete and Cement, Specification for Nonshrink Grout, Volume II (1949 Ed.)

3. U.S. Department of Commerce Product Standard (PS):
   PS 1 Construction and Industrial Plywood

4. The Florida Building Code latest edition

G. Modification of Applicable Publications: In the ACI and other publications referred to herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had substituted for "should" wherever it appears; reference to the "authority having jurisdiction", "Building Official", the "Structural Engineer", and the "Architect/Engineer" shall be interpreted to mean the Architect.

H. Mock-up: Mockups: Before casting concrete in above grade column construct a mockup to illustrate color and finish of work that will be exposed to public view. Build mockup to comply with the following requirements, using materials indicated for the completed Work: Also refer to specification 01 4339 Visual Mock-up Requirements.

1. Mockup shall consist of a 3’-0”x3’-0”x10” panel located within 10 feet of the proposed column. (LST, east side)
2. Mockup shall be completed not less than 45 days prior to the proposed date for placement of concrete column.
3. Mockup shall be finished to a class A finish as specified elsewhere in this section.
4. Concrete for the mockup shall be placed with sufficient time for curing to allow the concrete to reach specified minimum compressive strength before applying the abrasive blast finish.
5. Do not proceed with placement of concrete for column until the mockup has been approved by the architect.
6. The accepted mockups shall become the standard for judging acceptability of all concrete surfaces that will be exposed to public view.
7. Following acceptance of the finished column by the architect, remove the mockup from the project site and legally dispose of it.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver packaged materials to Project Site in original unopened and undamaged containers plainly labeled with manufacturer's name, product name and designation, expiration period for use, mixing instructions for multi-component materials, and other pertinent data. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breakage, and other causes.

B. Product handling shall comply with the applicable requirements of ACI 301, Chapter 2, Paragraph 2.5. Reinforcing bars and accessories shall be stored above the ground on platforms, skids, or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration.

C. Damaged or non-conforming materials shall be removed from the Project site and replaced with new materials satisfactory to the Architect at no additional cost to the Owner.

1.8 ENVIRONMENTAL CONDITIONS

A. Hot Weather Concreting: Comply with ACI 305R.

B. Inclement Weather: Under conditions of rain, the placing of concrete shall not commence unless adequate protection is provided to prevent damage to the surface mortar or damaging flow or wash of the concrete surface. During inclement weather conditions concrete shall be provided with adequate protection to prevent damage.

1.9 PROJECT CONDITIONS

A. Protection Against Spatter: Protect adjacent work, construction, and materials against spatter during concrete placement.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. General: Furnish all forms required or necessary to ensure that completed work is in accordance with the Contract Documents.

1. Responsibility for selection of proper form materials, for acceptable construction, alignment, and support of forms, and for proper wetting and precoating of forms, shall rest with Contractor.
2. Forms shall be furnished in the largest practicable sizes to minimize the number of joints and to conform to the joint system shown on the Contract Drawings or accepted on the approved shop drawings.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings or accepted on approved shop drawings.

1. Plywood Form Material: Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

D. Form Release: Provide commercial formulation form-release compounds with a maximum VOC of 350 mg/l that shall not bond with, stain, or adversely affect concrete surfaces.

E. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. For securing forms where surfaces will be exposed in the finished work, use tie screws with removable plastic cones, removable bolts, special removable ties, or series 300 stainless steel snap ties. For all other forms, use bolts or other approved ties.

1. Provide units that shall not leave any metal closer than 1-1/2 inches to finished exposed surface.
2. Provide ties that, when removed, shall not leave holes larger than 1-inch diameter in concrete surface.

2.2 REINFORCING MATERIALS

A. Reinforcing Bars:

1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.

2. Reinforcing Bars: ASTM A 615, Grade 60

a. Fabrication tolerances shall conform to ACI 315, Paragraph 4.3.

3. For slab reinforcement, AASHTO M 31 M grade 420, epoxy coated.
4. Welded Wire Fabric: ASTM A 185, for interior; and ASTM A 884, Class A for exterior concrete.
5. Supports for Reinforcement: Provide bolsters, chairs, spacers, and other devices required for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place.

   a. Use wire bar type supports complying with CRSI specifications.
   b. Provide supports with legs that are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2), for exposed to view concrete surfaces, where legs of support are in contact with forms.

B. Fiber Reinforcement:

1. Syntehtic Fiber: Provide fiber reinforcement for composite slab and wearing surface Fibrillated polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C1116, Type III, 1” to 2” long. Provide one of the following or approved equal:

   a. “Tuf-strand SF”; (Euclid Chemical Company)
   b. “Fibermesh 650”; (Propex Operating Company)
   c. “Grace Fibers”; (WR Grace & Co.)

2.3 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 100 miles of Project site from aggregates that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Cementitious Materials

1. Portland Cement: ASTM C 150, Type I or II.
   a. Use one brand of cement throughout Project, unless otherwise acceptable to the Architect. The alkali content shall not exceed 0.6 percent unless the manufacturer certifies that no alkali reactivity is produced with the proposed combination of materials when tested in accordance with ASTM C 227.
   b. Cement shall be a standard brand and shall meet the approval of the Architect.
   c. Cement, to be acceptable, shall be of a well-known brand which has been in successful use for large engineering works in the United States of America for at least 10 years, and which has an established reputation for uniform character, and which, by their records, show a tendency to maintain high strength of mortar with increased age.
2. Fly Ash: ASTM C 618, Class F, 20% maximum by weight.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120, 25% maximum by weight.
4. The contractor shall provide a minimum of 10% by weight fly ash or slag in all concrete mix designs.

C. Normal Weight Aggregates: Unprocessed pit-run or naturally mixed aggregates will not be permitted. Naturally mixed aggregates must in every case be screened and washed, and all fine and coarse aggregates shall be stored and handled as specified herein. Use aggregate from the same source for all Class A concrete to ensure consistency in color.

1. Fine Aggregate shall be natural sand or stone screenings, or a combination thereof. All fine aggregate shall conform to the requirements of ASTM C 33, except as modified herein, and shall be graded within the limits specified in Table 1.

TABLE 1 - GRADATION FOR FINE AGGREGATE

Sieve Designation	Percentage by Weight Passing Square Mesh Sieve
3/8 inch	100
No. 4	95 - 100
No. 16	45 - 80
No. 30	25 - 55
No. 50	10 - 30
No. 100	2 - 10

2. Blending of manufactured sand fractions, manufactured sand and natural sand, or of two natural sands, when required to meet the gradation requirements or to obtain workable mixes, shall be performed at the batch plant.
3. The amount of deleterious substances in fine aggregate, each determined independently on samples complying with the grading requirements, shall not exceed the limits listed in Table 2.

TABLE 2 - DELETERIOUS SUBSTANCES-FINE AGGREGATE

Item	Maximum Percent by Weight
Clay Lumps	1.00
Shale	1.00
Coal and Lignite	.25
Materials Finer than No. 200	3.00
Total Combined Deleterious Sub-stances	5.00

4. In addition to the requirements of ASTM C 88, the sodium sulphate soundness test, provide evidence, satisfactory to the Architect that the fine aggregate has been exposed to natural weathering, either directly or in concrete, for a period of at least 5 years without appreciable disintegration. In the case where new sources are recently developed, at the option of the Architect, the service requirement may be waived and the aggregate shall be subjected to testing under the provisions of AASHTO T-103, "Soundness of Aggregates by Freezing and Thawing". If the weighed percentage of loss at the end of 50 cycles does not exceed 10 percent, the fine aggregate shall be accepted as pertains to soundness requirements.

5. Coarse Aggregate shall be crushed stone or gravel conforming to the requirements ASTM C 33 size #57 or 67.

    a. The amount of deleterious substances in coarse aggregate, each determined on independent samples complying with the designated grading requirements, shall not exceed the limits specified in ASTM C 33.

6. Water: Natural, drinkable, with no pronounced taste, odor, impurities, suspended particles, or dissolved natural salts in quantities detrimental to reinforcing or concrete.

D. Water-Reducing Admixture: ASTM C 494, Type A, except as modified by applicable local code requirements of the authority having jurisdiction. Structural concrete shall contain a water reducing (plasticizing) admixture. Subject to compliance with requirements, provide one of the following products:

1. "Eucon WR-75" (Euclid Chemical Co.).
2. "Pozzolith 200N" (Master Builders Co.).
3. "Plastocrete 161" (Sika Chemical Corp.).
4. Or approved equal

E. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and containing not more than 0.1 percent chloride ions. Subject to compliance with requirements, provide one of the following products:

1. "Daratard-17"; W.R. Grace.
2. "Plastiment"; Sika Chemical Co.
3. "Pozzolith Retarder"; Master Builders.
4. Or approved equal

F. Crystaline Integral Concrete Waterproofing Admixture:

1. Where indicated on drawings provide a permeability reducing admixture for hydrostatic conditions in accordance with ACI 212.3R-10, Chapter 15. Dosage shall be equal to 1.5% of the total weight of all cementitious content of the mix but shall not exceed pounds per cubic yard. Supply admixture in sealed buckets or in disintegrating paper bags.

2. Provide one of the following products or approved equal:
   a. Krystol Internal Membrane, Kryton International, Inc.
   b. Xypex Admix C-500, Xypex Chemical Corp.
   c. Vandex AM 10, Vandex International, Ltd.

G. Other Admixtures: Use only with the prior written approval of the Architect. Do not use any admixtures which contain chlorides.

2.4 RELATED MATERIALS

A. Concrete Topping Materials: Where applied concrete slopes to drain are indicated provide one of the following products or approved equal. Mixing and application shall be in strict accordance with manufacturer's written instructions. Products may be extended if permitted by the manufacturer.

1. SikaTop 122 Plus, Sika Corporation
2. Master Emaco t 302, BASF Corporation
3. TammsPatch II, Euclid Chemical Company

B. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.

C. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.

1. Waterproof paper.
2. Polyethylene film.
3. Polyethylene-coated burlap.

D. Expansion/Contraction Joint Filler: ASTM D 1751 or ASTM D 1752, 1/2-inch thick, unless otherwise indicated.

E. Expansion Anchors: Expansion anchors shall be stud type with a single piece three-section wedge and zinc plated in accordance with ASTM B 633. Anchors shall meet the description requirements indicated in Federal Specification FF-S-325, Group II, Type 4, Class I for concrete expansion anchors.

1. Anchors shall be Hilti Kwik Bolt TZ as supplied by Hilti Fastening Systems or approved equal.
2. Anchors shall be installed in holes drilled with Hilti, or approved equal, carbide tipped drill bits.
3. Anchors shall be installed per manufacturer's recommendations.

F. Nuts and Washers: ASTM A 563.

1. Nut heads shall be hexagonal.

G. Non-Shrink, Non-Metallic Grout: Factory pre-mixed grout product complying with U.S. Army Corps of Engineers Handbook CRD-C-621. Subject to compliance with requirements, provide one of the following:

1. "Euco-NS"; Euclid Chemical Co.
2. “Five Star Grout"; U.S. Grout Corp.
3. "Set Grout"; Master Builders.
4. Or approved equal

H. Chemical Dustproofer and Hardener: Colorless aqueous solution containing a blend of magnesium fluosilicate and zinc fluosilicate combined with a wetting agent, containing not less than 2 lbs. of fluosilicate per gallon. Subject to compliance with requirements, provide one of the following products:

1. “Burk-O-Lith"; The Burke Company
2. "Masterplate 200"; Master Builders
3. "Lapidolith"; Sonneborne-Rexcord.

I. Epoxy Bonding Compound: ASTM C 881, Type V for load bearing applications, Grade 1, Class A (if placement temperature is below 40 degrees F); Class B (if placement temperature is between 40 and 60 degrees F); or Class C (if placement temperature is above 60 degrees F). Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces.

J. Steel plates shall conform to ASTM A36.

K. Stud welding shall conform AWS D1.1.

L. VAPOR RETARDERS

1. Sheet Vapor Retarder: ASTM E 1745, Class A, 15 MIL. Include manufacturer's recommended adhesive or pressure-sensitive tape.
   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) Poly-America, L.P.
      2) Stego Industries, LLC.
      3) W. R. Meadows, Inc.

2.5 PROPORTIONING AND DESIGN OF MIXES

A. Preparation of Design Mixes: Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301.

B. Mix Design Reports: Submit written reports to the Architect of each proposed mix for each class of concrete at least 28 days prior to the first concrete placement. Do not begin concrete production until proposed mix designs have been reviewed by the Architect. Review by the Architect shall not be deemed to relieve any obligation to provide cast-in-place concrete in accordance with the Contract Documents.

C. Design of Mixes: Design mixes to produce concrete of proper workability, durability, strength, maximum density, minimum shrinkage, and permeability. Assume full responsibility for the strength, consistency, water-cement ratio, and handling of concrete.

1. Design mixes to have minimum water content per cubic yard of concrete, cement content corresponding to appropriate water-cement ratio, largest permissible maximum size specified of coarse aggregate available, and optimum percentage of fine aggregate.
2. Use water-cement ratio in accordance with ACI 211.1 and ACI 211.2 as determined by type of structure and exposure conditions, or 0.45 by weight, whichever is less, as approved and supplemented or modified as specified herein.
    a. Water-cement ratio shall not exceed 0.40 by weight for concrete to receive a Class A finish.

3. Trial mixtures shall be made based on at least three different water-cement ratios. Trial mixes shall be proportioned to produce concrete strengths specified below. Trial mixtures shall be designed for maximum permitted slump and air content. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results a curve shall be plotted showing the relationship between water-cement ratio and strength. For each strength of concrete the maximum allowable water-cement ratio shall be that shown by these curves to produce the strength specified.
4. The concrete used in the work shall be produced using a water-cement ratio corresponding to a point on the strength vs. water-cement ratio curve representing a strength, at the design slump, in accordance with ACI 318 or at least 25 percent higher than that indicated or specified, whichever is greater. When the Contractor demonstrates to the satisfaction of the Architect that his quality control warrants a change in the 25 percent factor, a change will be permitted. However, in no case shall the concrete strength used in construction be less than 15 percent higher than that specified or indicated.
5. The approved laboratory prepared mix design proportions shall govern during the progress of the work. If concrete having the required consistency cannot be produced without exceeding the maximum allowable water-cement ratio, the cement content shall be increased so the maximum allowable water-cement ratio is not exceeded.
6. Use approved chemical admixtures, air-entraining admixtures or suitable combinations thereof to improve workability, as well as to reduce water and cement content or minimize shrinkage and permeability of concrete, provided such admixtures do not adversely affect other specified properties of concrete.

7. Admixtures shall be added within a limit of accuracy of 3 percent and dispensed to the mixing water by means of an approved, graduated, transparent measuring device before they are introduced into the mixer. If more than one admixture is to be used, they shall be released into the mixing water in sequence rather than at the same instant. Once established, the sequence of dispensing admixtures shall not be altered. Admixtures shall be used in accordance with the manufacturer's recommendations. However, when the amount of admixture required to give the specified results deviates appreciably from the manufacturer's recommended dosage, use of the material shall be discontinued.
8. Adjust the consistency of concrete mixes to allow for specific placing conditions. Measure materials for concrete by weighing. Separately weigh cement and each size of aggregate, each accurate within 1%. Cement in sacks of ninety-four pounds need not be weighted. Weigh bulk cement and fractional packages. Measure mixing water by volume, and within 1 percent of quantity required.

D. Design Mixes:

1. Concrete for Cast in Place Concrete Pile Caps, Grade Beams and Slabs on Grade: Design mixes to provide normal weight concrete with a minimum of 4000 psi compressive strength at 28 days.

2. Concrete for Cast in Place Concrete Columns:
   a. Design mixes to provide normal weight concrete with a minimum compressive strength at 28 days.
      1) LST – 5000 psi
      2) Promenade – 6000 psi
      3) Pedestrian Bridge – 6000 psi

   b. Lightweight Concrete: Proportioning, mixing, transporting, placing, finishing, and curing of lightweight concrete shall conform to the applicable requirements for normal weight concrete, together with the additions and modifications specified herein.
      1) Use lightweight aggregates for lightweight concrete in accordance with ACI Standards 211.2. and 213 R.
      2) Concrete on metal decking shall be lightweight concrete having a minimum compressive strength of 4000 psi at 28 days and shall have 5 lbs/cy fiber reinforcement. Maximum unit weight at 28 days shall be 115 lbs/cf.
      3) Proportioning, mixing, transporting, placing, finishing, and curing shall be as recommended by the lightweight concrete producer.

E. Adjustment to Concrete Mixes: Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by the Architect.

1. Laboratory test data for revised mix design and strength results shall be submitted to and accepted by the Architect before using in work.

F. Admixtures: Use water-reducing admixture in concrete as required for placement and workability.

1. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 degrees F.

2. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.
3. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits.
4. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

G. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as follows:

1. Slabs and Sloping Surfaces: 3” +/- inches prior to admixtures.
2. Other Concrete: 4” +/- inches prior to admixtures..

2.6 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with requirements of ASTM C 94, supplemented and amended as specified herein.

1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. Discharge the concrete completely at the site within 1-1/2 hours after the introduction of the cement to the aggregates. Reduce this time limit in hot weather to prevent stiffening of concrete until after it has been placed. Begin the mixing operation within thirty minutes after the cement has been intermingled with the aggregates.
2. Ready-Mix Concrete Delivery Tickets: Before unloading at the site, provide a delivery ticket from concrete supplier with each batch delivered to the site bearing the following information:
   a. Name of supplier.
   b. Name of batching plant and location.
   c. Serial number of ticket.
   d. Date.
   e. Truck number.
   f. Specific job designation, location, complete Project Name, and ProjectNumber.
   g. Volume of concrete in cubic yards.
   h. Class and type of concrete.
   i. Time loaded.
   j. Type and brand of cement.
   k. Weight of cement.
   l. Maximum size of aggregates.
   m. Source of aggregates.
   n. Type of aggregate.
   o. Weight of coarse aggregate.
   p. Weight of fine aggregate.
   q. Maximum amount of water to be added and amount of water added at the site.
   r. Kind and amount of admixtures.
   s. Mix design designation,
   t. Signature of a certified plant batcher, or a certified plant concrete technician, or a responsible officer or other authorized employee of the concrete supplier.

B. Batch Mixing at Site: Comply with ACI 301, Chapter 7, Paragraph 7.2, supplemented and amended as specified herein.

1. Excessive mixing, requiring the addition of water to preserve the required consistency shall not be permitted. Mix concrete to a consistency which can be readily placed without segregation. Where admixtures are specified, equip mixers with a device for measuring and dispensing the admixture.
   a. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, amount of water introduced, revolution counter readings, aggregate dial settings, the class of concrete delivered, and mixer operator's signature.
   b. Delivery tickets shall also indicate the strength of the concrete being delivered, the type of coarse aggregate (i.e. lightweight or stone) and, the exact time the cement and aggregate were discharged into the delivery truck, and a list of admixtures.

C. Hand-Mixed Concrete: Hand-mixed concrete is not allowed.

D. Retempering: Comply with ACI 301, Chapter 7, Paragraph 7.5. The following are in addition to requirements specified in ACI 301, Chapter 7, Paragraph 7.5. Retempering concrete by adding water or by other means will not be permitted except when concrete arrives at the project with slump below that suitable for placing. Water may be added only if neither the accepted mix design water-cement ratio nor the maximum slump is exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required. Such water addition shall be acceptable to the Architect and shall be performed under the supervision and sanction of the Testing Laboratory.

1. Concrete that becomes non-plastic, unworkable, or outside of the limits of the slump specified shall not be used. Concrete which has set shall be discarded and shall not be retempered.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. A pre-installation meeting shall be held.

1. Prior to the commencement of any work under this Section, and when directed by the Architect, meet at the Project Site to review installation and coordination procedures. Among other topics, the coordination meeting shall address scheduling, method and sequence of concrete construction, standard of workmanship, material selection, testing and quality control requirements, detailed requirements of design mixes, placement procedures, off-site batching requirements, coordination of the Work with other trades, preparation of surfaces contiguous with this work, adjacent construction, and interferences, if any. This meeting shall be attended by any and all trades, manufacturer's representatives, and other interested parties whose work will be affected by the execution of the work under this Section.

3.2 FORMS

A. Formwork: Design, erect, support, brace, and maintain formwork to support vertical, lateral, static, and dynamic loads that might be applied until concrete structure can support such loads. Forms shall be well constructed, carefully aligned, substantial, firm, securely braced and fastened together in their final position and set to give the finished structure the specified camber, plus allowance for shrinkage and settlement. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain formwork construction complying with ACI 347R. Tolerances shall conform to ACI 301, Paragraph 4.3, unless otherwise indicated or specified.

1. Hydraulic Pressure: Design forms, studs and wales to limit deflections between supports to 1/360th of the span. All joints, gaps and apertures in forms, wherever located shall be gasketed, plugged or sealed with a suitable material so that they will withstand the full concrete hydraulic pressure and remain watertight.
2. Tolerances and Finish Lines: Position formwork to maintain hardened concrete finish lines within the following permissible deviations:
    a. Variation from Plumb
        1) In any 10 ft.: 1/4 in.
        2) In 40 ft. or more: 1/2 in.
        3) Cross-Sectional Dimensions: Minus 1/8 in., Plus 1/4 in.
        4) Surface Tolerances: Maximum offset between butt joints of individual or ganged forms: +/- 1/32 in.
    b. Variation from Building Line: Variation of the linear building lines from established position to plan and related position of columns and walls:
        1) In any 10 ft.: 1/4 in.
        2) In 40 ft. or more: 1/2 in.
    c. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials. Prying against the face of the concrete will not be permitted. Only wooden wedges shall be used.
    d. Forms shall be strong enough to prevent fresh concrete from bulging the forms between supports and to withstand the action of mechanical vibrators. Provide for openings, offsets, sinkages, keyways, recesses, reglets, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features required in work.
    e. Position Tolerances: For cast-in items measured from datum line locations as shown on reviewed shop drawings:
        1) Blockouts and Reinforcements: Within 1/4 in. of position shown on shop drawings, where such positions have structural implications or affect concrete cover; otherwise within plus or minus 1/2 in.
        2) Anchors and Inserts: Within 3/8 in. of centerline location.
3. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
4. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

5. Exposed joint edges and external corners shall be chamfered a minimum of 3/4-inch, unless otherwise specified or indicated. Where new concrete abuts existing concrete, match existing chamfers. Use wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
6. In long spans, where intermediate supports are not possible, the anticipated deflection in the forms due to weight of fresh concrete shall be accurately figured and taken into account in the design of the forms, so that finished concrete members will have true surfaces conforming accurately to required lines, planes, and elevations.
7. Bolts and rods used for temporary internal form ties shall be so arranged that when the forms are removed, all metal will be not less than 1-1/2 inches from any finish concrete surface. Wire ties will not be permitted. The design of form ties shall be subject to the approval of the Architect.
8. Where shoring bears on ground, spread load from shores by suitable mud sills in order to prevent settlement. Where height of shores exceed ten feet, provide adequate diagonal bracing in both longitudinal and transverse directions. In addition, provide adequate diagonal braces at end of framework. Diagonal bracing shall extend from top to bottom of shores. Unbraced length of wood shores supporting forms shall not exceed fifty times least dimension.
9. Strike off concrete at top of forms and screed with wood to a float finish.

B. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.

C. Rustication Strips: Mill rustication strips smooth to avoid protruding splinters which may become embedded in the concrete.

D. Construction Joints: Construction joints shall be at locations shown or as approved on Shop Drawings. Remove loose material from the surface prior to the erection of forms. The formwork for the succeeding lift shall be held tight against the top of the previous lift and gasketed or caulked to prevent leakage.

E. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed as necessary to obtain the smooth surfaces required. Retighten forms and bracing before concrete placement so as to prevent mortar leaks and maintain proper alignment.

F. PREPARATION OF FORM SURFACES

1. Clean re-used forms of concrete matrix residue in accordance with ACI 301, Paragraph 4.4, repair and patch as required to return forms to acceptable surface condition.
2. Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before reinforcement is placed.
3. Moisten wood forms immediately before placing concrete where form coatings are not used.

4. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete shall be placed. Apply in compliance with manufacturer's instructions.
5. Coat steel forms with a non-staining, rust-preventative material. Rust-stained steel formwork is not acceptable.

3.3 VAPOR-RETARDER INSTALLATION

1. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

2. Lap joints 6 inches and seal with manufacturer's recommended tape or per manufacturer’s recommendations.

3.4 PLACING REINFORCEMENT

A. CRSI Requirements: Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified.

1. Avoid cutting or puncturing vapor retarder during reinforcement placement and concreting operations. Placing tolerances shall comply with ACI 301, Chapter 5,Paragraph 5.6. When splices not shown on the Drawings are approved by the Architect, such splicing shall conform to ACI 318.
2. Place reinforcing bars having assigned positions so that they agree with those given on the shop drawings relating to or calling for the bars.
3. Secure reinforcing bars in place with high-density plastic supporting and spacing devices and metal tying devices. Reinforcing in concrete members that have one or more surfaces exposed, whether painted or unpainted finish, shall be tied with 14 gage soft annealed galvanized wire. Uncoated tie wire in exposed members shall not be accepted.
4. Restore damaged bars to full capacity in accordance with CRSI requirements and in a manner acceptable to the Architect.

B. Cleaning Reinforcement: Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that reduce or destroy bond with concrete.

C. Positioning, Supporting, and Securing Reinforcement: Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required and approved by the Architect. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces. Comply with ACI 301, Paragraph 5.

D. Installation of Welded Wire Fabric: Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. Expansion Joints: Expansion joints shall be provided as indicated on the Contract Drawings. Unless otherwise shown, do not extend reinforcement or other embedded metal items through any expansion joints. Expansion joints shall be provided with premolded fillers and waterstops where shown.

B. Contraction Joints: Provide horizontal contraction joints in slabs by soft cutting, and in walls by formed or saw cutting to the indicated depth after the surface has been finished. Sawed joints in horizontal surfaces shall be completed within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

C. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength. Joints shall be provided by placing concrete in alternate pours not sooner than 72 hours of the placing of contiguous members. Waterstops shall be provided where indicated.

1. Provide keyways at least 1-1/2 inches deep, unless otherwise shown, in construction joints in walls and slabs and between walls and footings.
2. Unless otherwise indicated, place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.

D. Bonding Construction Joints: Bonding of construction joints shall conform to the requirements specified. In joining fresh concrete to set concrete, the work already in place shall have its surface roughened thoroughly. All loose and foreign material shall be removed. The surface shall be washed and scrubbed with wire brooms when necessary to remove substances that will interfere with bonding. Concrete of the preceding placement shall be thoroughly wetted prior to placement of the next unit of fresh concrete.

3.6 INSTALLATION OF EMBEDDED ITEMS

A. Setting Anchorage Devices: Set and build into work anchorage devices and other embedded items required for other work that is attached to or supported by cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto.

B. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to obtain required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

C. Embedded Steel Items: Insure that all required steel members required to be cast into concrete are properly placed and secured. In particular, coordinate the work with Section 055000, "Metal Fabrications" and drawing details.

3.7 CONCRETE PLACEMENT

A. General: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Comply with

ACI 304, "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete", supplemented and amended as specified herein.

1. Do not place concrete when sun, heat, wind, or limitations of facilities shall prevent finishing and curing.
2. Deposit concrete as closely as possible to its final position to avoid rehandling. Deposit concrete continuously or in layers of such thickness that no concrete shall be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete to avoid segregation at its final location. Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
3. Force the concrete under and around the reinforcement without displacement. Avoid jarring the forms or placing any strain on the ends of projecting reinforcement after the concrete has taken its initial set.
4. Do not place concrete which has attained initial set. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 85 degrees F. Reduce mixing time and place concrete within 75 minutes if the air temperature is between 85-90 degrees F. Further reduce mixing and placement time to 60 minutes when the air temperature is above 90 degrees F. Retempering of concrete which has partially set is prohibited.
5. Cast-in-place concrete shall not be mixed, placed, or finished without sufficient natural light or an adequate and accepted artificial lighting system. Do not place concrete when weather conditions detrimentally affect the quality of finished work.
6. When placing operations would involve dropping the concrete more than 5 feet, the concrete shall be dropped through a tube fitted with a hopper head, or through other approved devices, as necessary to prevent segregation of the mix and spattering of mortar on forms above the elevation of the lift being placed.

B. Preparation Before Placing: Conform to ACI 301, Chapter 8, Paragraph 8.1, and as specified.

1. Apply temporary protective covering to lower 24 inches of finished work and guard against spattering during placement.
2. Clean mixer thoroughly prior to batching all concrete. Load truck mixers at only the capacity which will ensure a uniform batch at the slump specified. In the event that mixing in any truck mixer is not uniform, the truck load will be rejected and shall not be used on the Project.
3. Handle concrete from the mixer to the place of final deposit as rapidly as practical by methods which prevent separation or loss of the ingredients.
4. Clean transporting and handling equipment at frequent intervals and flush thoroughly with water before and after each day's run.

C. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309, supplemented and amended as specified herein.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. Limit duration of vibration at each insertion to time necessary to consolidate concrete and to complete embedment of reinforcement and other embedded items without causing segregation of mix.

D. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners. Maintain reinforcing in proper position during concrete placement.
2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

E. Hot-Weather Placing: Place concrete in compliance with ACI 305 and as herein specified when hot weather conditions exist that would impair quality and strength of concrete.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 95 degrees F. Mixing water may be chilled, or chopped ice may be used to control temperature provided, that when ice is used it shall be added with the water and counted as part of the water-cement ratio.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature shall not exceed the ambient air temperature immediately before embedment in concrete.
3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
4. Use water-reducing retarding admixture when required by high temperatures, humidity, or other adverse placing conditions, when acceptable to the Architect.

F. Conveying:

1. Comply with ACI 301, Chapter 8, Paragraph 8.2. and ACI 304R.
2. Provide a spout or downpipe and elephant trunk or other appropriate method to prevent concrete from falling freely through a height greater than 5 ft. Free fall in walls and columns shall not exceed 15 ft.
3. Pumping: ACI 304R and ACI 304.2R. Pumping shall not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment shall not exceed 2 inches. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy. Minimum size of pipe diameter shall be 5 inches. Rapid changes in pipe sizes shall be avoided. Maximum size of coarse aggregate shall be limited to 33 percent of the diameter of the pipe. Maximum size of well rounded aggregate shall be limited to 40 percent of the pipe

diameter. Samples for testing shall be taken at both the point of delivery to the pump and at the discharge end.

4. Placing concrete by pumping will be permitted only when authorized by the Architect. Equipment shall be arranged such that no vibrations that might damage freshly placed concrete will occur. Equipment shall be thoroughly cleaned prior to use. The operation of the pump shall be such that a continuous stream of concrete without air pockets is delivered. If concrete remaining in the pipe line is to be used, it shall be ejected in such a manner that there will be no contamination of concrete or separation of ingredients.

G. Vibration: Conform to ACI 309. Concrete shall be thoroughly consolidated during and immediately following placement. Consolidation shall be accomplished by mechanical vibration subject to the following provisions:

1. Vibration shall be internal to the concrete but not applied directly to reinforcement or formwork.
2. Vibrators shall be per ACI 309R

   a. Vibrators used to consolidate concrete containing epoxy-coated bar reinforcement shall have a resilient covering to prevent damage to such reinforcement.
   b. The intensity of vibration shall visibly affect a mass of concrete over a radius of at least 18 inches.
   c. Provide a sufficient number of vibrators to consolidate each batch immediately after it is placed in forms.
   d. Vibrators shall be manipulated to work concrete thoroughly around reinforcement and embedded fixtures and into corners and angles of forms.
   e. Vibration shall be applied at the point of deposit and in the area of the freshly placed concrete.
   f. Vibrators shall not be pulled through concrete and shall be inserted, withdrawn slowly and maintained nearly vertical at all times.
   g. Vibration shall be of sufficient duration and intensity to consolidate concrete thoroughly but shall not be continued so as to cause segregation.
   h. Vibration shall not be continued at any one point to the extent that localized areas of grout are formed.
   i. Application of vibrators shall be at points uniformly spaced and not further apart than 1 1/2 times the radius over which the vibration is visibly effective.
   j. Vibration shall be supplemented by such spading as is necessary to ensure smooth surfaces and dense concrete along form surfaces and in corners and locations inaccessible to vibrators.
   k. External vibrators shall be used on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.
   l. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer.
   m. Do not insert vibrators into lower layers of concrete that have begun to set.
   n. Limit duration of vibration at each insertion to time necessary to consolidate concrete and to complete embedment of reinforcement and other embedded items without causing segregation of mix.

3.8 SURFACE FINISHES

A. Not Against Forms (Top of Walls): Surfaces not otherwise specified shall be finished with wood floats to even surfaces.

B. Formed Surfaces:

1. Class A per ACI 347 R14 - 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. Class A permits gradual or abrupt irregularities of +1/8 inch.
   a. Apply to concrete surfaces - exposed to view

2. Class B per ACI 347 R14 Coarse textured 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. Class B permits gradual or abrupt irregularities of +1/4 inch.
   a. Apply to concrete surfaces - covered with a coating or covering material applied directly to concrete. Coordinate texture with covering material.
3. Class C per ACI 347 R14 - Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities. Class C permits gradual or abrupt irregularities of +1/2 inch.
   a. Apply to concrete surfaces – not exposed to view.
4. Class D per ACI 347 R14 - 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. Class D permits gradual or abrupt irregularities of +1 inch.
   a. Apply to concrete surfaces – foundations not exposed to public view.

C. In order to secure a satisfactory "true and even surface," the surface of the concrete shall, where required, be rubbed down in an approved manner to the extent necessary.

D. The quality of casting and the finished members shall be subject to inspection and approval by the Architect. Individual members may be rejected because of any of the following:

1. Variations in the exposed face that substantially deviates from designated standards.
2. Dimensions not conforming to designated tolerances.
3. Defects which would affect the structural integrity, physical characteristics, or architectural appearance of the member.
4. Defects that indicate imperfect casting or forming.
5. Defects indicating honeycombed concrete, cracks, casting fractures, exposed reinforcing steel, or insufficient concrete compressive strength.
6. Concrete exposed to public view does not match the on-site reference sample in color or texture.
7. Shrinkage cracking beyond acceptable ACI standards.

E. The Architect will determine whether defective concrete shall be repaired or rejected. Repair of concrete, if allowed, shall be done in a manner satisfactory to the Architect.

Repair to concrete surfaces which will be exposed- to-view after completion of construction shall be subject to approval by the Architect.

F. Repair formed surfaces by removing minor honeycombs, pits greater than one square inch surface area or 0.25 inches' maximum depth, or otherwise defective areas, as determined by the Architect. Provide edges perpendicular to the surface and patch with patch material. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb (including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects) which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete shall not vary more than the allowable tolerances of ACI 347. Exposed surfaces shall be uniform in appearance and finished to a smooth form finish unless otherwise specified.

G. Slab, and Pavement Finishes and Miscellaneous Construction: ACI 302.1R, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Provide interior floor slabs with a steel troweled finish.

1. Concrete floors shall meet the following floor flatness and levelness tolerances:

    a. Slabs Cast on Grade: Ff=20; Fl=17 (as defined by ASTM E1155) unless noted otherwise on the drawings.
    b. Slabs Cast on Metal Deck: Ff=20 unless noted otherwise on the drawings.

2. Dustproofing: Provide dustproofer on concrete floor surfaces: After trowelling, apply two (2) coats of dustproofer, in accordance with the approved manufacturer's printed instructions.
3. Finishing: Place, consolidate, and immediately strike-off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

    a. Floated: Provide for machinery pads and exterior slabs where not otherwise specified. Float the surface by hand with a wood or magnesium float, or use a power-driven float. Floating of any one area shall be the minimum necessary to produce an even finish, level within 1/4 inch in 10 feet for exterior work and level within 1/8 inch in 10 feet for interior work where floor drains are not provided.
    b. Steel Troweled: Provide for interior floor slabs. First, provide a floated finish. When slab attains a proper set, trowel to a smooth, hard, dense finish. Finished surfaces shall be free of troweled marks, uniform in texture, and a true plane, flat within 0.01 foot (approximately 1/8 inch) in 10 feet. Hand-finish portions of the slab not accessible to power finishing equipment (e.g., edges, corners) to match the remainder of the slab. Power trowel twice and finally hand trowel for exposed concrete floors.
    c. Broomed: Provide for exterior walks, platforms, patios, and ramps, unless otherwise indicated. Provide a floated finish, then finish with a flexible bristle broom. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

d. Areas to receive floor coatings the floor finish shall be per the manufacturer's recommendations.

4. Concrete Saw Cutting: When sawing of joints is specified, provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions and at the required rate. Provide at least one standby saw in good working order. An ample supply of saw blades shall be maintained at the site of the work at all times during sawing operations. Provide adequate artificial lighting facilities for sawing. All of this equipment shall be on the job both before and at all times during concrete placement.

   a. When joints in concrete are sawed, the joints shall be cut as shown on the plans. The circular cutter shall be capable of cutting a groove in a straight line and shall produce a slot indicated, and to the depth shown. When shown on the plans or required by the specifications, the top portion of the slot or groove shall be widened by means of a second shallower cut or by suitable and approved beveling to provide adequate space for joint sealers. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing. Sawing shall be carried on both during the day and night as required. The joints shall be sawed at the required spacing consecutively in sequence of the concrete placement, unless otherwise approved by the Architect.
   b. Provide backup rod and sealant which is fuel resistant as specified under other Sections of the specifications.

3.9 CONSTRUCTION TOLERANCES

A. Variation in alignment, grade, and dimensions of structure from established alignment, grade, and dimensions shown on the Drawings shall be within the tolerances as specified within ACI 117-

3.10 CONCRETE CURING AND PROTECTION

A. Protection: Protection of concrete shall begin immediately following concrete placement in the formwork and shall continue without interruption during the curing period. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather, protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply in accordance with manufacturer's instructions after screeding and bull floating, but before floating.

B. Initial Curing: Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting, keep continuously moist for not less than 7 days.

C. Final Curing: Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 7 days in accordance with ACI 301 procedures, supplemented and amended as specified herein. Avoid rapid drying at end of final curing period.

D. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, or by combinations thereof, as herein specified or by the application of a spray applied, membrane type curing compound. Moist curing is the only method allowed for concrete having a water-cement ratio of 0.40 or less.

1. Moisture Curing: All material, equipment, and labor necessary to promptly apply the moist curing shall be on Project Site before any concrete is placed. Provide moisture curing in accordance with ACI 308 and by the following methods.

a. Keep concrete surface continuously wet by covering with water.
b. Use continuous water-fog spray.
c. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4-inch lap over adjacent absorptive covers.
d. The entire surface of the concrete shall be kept damp by applying water with a nozzle that so atomizes the flow that a mist and not a spray is formed. The moisture from the nozzle shall not be applied under pressure directly upon the concrete and shall not be allowed to accumulate on the concrete in a quantity sufficient to cause a flow or wash the surface.
e. The rate of water application shall be controlled to the maximum rate that can be applied without causing excessive runoff, spattering, splashing, or other water damage. Steps shall be taken to properly protect surrounding work and construction from damage by water or water runoff. The nozzle size, water pressure, sprinkling or wetting equipment, etc., shall be adjusted and regulated so that the optimum quantity of water is applied to the curing area. Care shall be taken to insure that the overlay absorptive cover is clean, thoroughly saturated over its entire area, drained of excess water, and remains flat at all times.
f. Curing shall be done so that the concrete is always moist. Improperly cured concrete will be considered defective. Failure to use, or lack of water to adequately provide for curing requirements shall be cause for immediate suspension of concrete placing operations. Placing operations shall not be resumed until proper procedures are used.
g. Failure to completely cover concrete surfaces with saturated absorptive covers immediately after the concrete has been placed shall be cause for rejection as determined by the Architect.
h. After moisture curing has been properly completed, sprinkling equipment, wetting lines, connections, and appurtenances shall be removed in a manner acceptable to the Architect and the work left in a first class and satisfactory condition. Any damage shall be repaired or the damaged work replaced to the satisfaction of the Architect at no additional cost to the Owner.
i. Cured concrete shall be uniform in color, texture, and finish, with no objectionable form marks or irregularities. Concrete containing plastic shrinkage cracks will be considered defective and shall be repaired or removed and replaced as directed by the Architect at no additional cost to the Owner.
j. Continuous sprinkling coverage shall be complete, shall prevent loss of moisture from the entire concrete surface, and shall prevent early drying shrinkage.

k. Continuous wetting shall be replaced by wetting at regular intervals if, in the opinion of the Architect, expected ambient air temperature could result in freezing of run-off water.
l. Concrete shall not be left exposed for more than 30-minutes during the curing period.

2. Moisture Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Spray Applied, Membrane Type Curing Compound:

a. Before using a membrane type curing compound, verify compatibility with proposed floor finishes.
b. Apply at the maximum rate recommended by the compound manufacturer.
c. Apply curing compound immediately after finishing operation have been completed.
d. Provide two coats of curing compound applied at right angles to each other.

E. Curing Formed Surfaces: For vertical and other formed surfaces, after the concrete has hardened and the forms are removed apply curing compound.

F. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, pile caps and other flat surfaces, by application of appropriate curing method.

G. Condition of Cured Concrete: Cured concrete shall be uniform in color, texture, and finish, with no objectionable form marks or irregularities.

3.11 REMOVAL OF FORMS

A. Do not remove forms until the concrete has thoroughly hardened and has attained sufficient strength to support its own weight and construction live loads to be placed thereon, without damage to the structure. In general, do not disturb forms for framing until the concrete has attained at least 40% of design strength for side forms and 80% of design strength for bottom forms.

1. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and similar structural elements may not be removed in less than 14 days or until the concrete has achieved at least 80 percent of its 28-day design compressive strength.
2. Assume all responsibility for proper form removal, and replace any work damaged due to inadequate maintenance or improper or premature form removal.
3. Any work, labor materials, etc., required to effect such replacement shall be provided at no additional cost to the Owner.

B. If used, and unless directed by the Architect, stripping cylinders shall be taken as follows:

1. 6 during the first two hours of the pour and 6 during the last two hours of the pour. These shall be broken into 3 sets of four cylinders; 2 from the samples taken during the first two hours and 2 from the samples taken during the last two hours of the pour. One set of 4 cylinders shall be tested at 2 days, one set at 3 days and one set at 4 days after the pour, or at such intervals of time as are consistent with the expected time of form removal, or as directed by the Architect.

C. Any defective work disclosed after the forms have been removed shall be removed and replaced immediately. If any dimensions are deficient, or if the surface of the concrete is bulged, uneven, or shows honeycomb which cannot be repaired satisfactorily in opinion of the Architect, the entire section shall be removed and replaced at no additional the expense to the Owner. When defects in work do not, in the opinion of the Architect justify removal and replacement, such work shall be patched or otherwise repaired immediately to the satisfaction of the Architect.

3.12 REUSE OF FORMS

A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated, or otherwise damaged form-facing material shall not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.

B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to the Architect.

3.13 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

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

C. Equipment Bases, Pads and Foundations: Provide machine and equipment bases, pads and foundations, as shown on the Contract Drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.

1. The concrete to be provided beneath the various pieces of mechanical and electrical equipment shall be at locations shown, however, the extent shall be governed by the configuration of the equipment finally selected and approved by the Architect.

3.14 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to the Architect. Comply with ACI 301, Chapter 9, supplemented and amended as specified herein.

1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar before bonding compound has dried. Apply patching material per manufacturer’s recommendations.
2. Remove and replace concrete that, in the Architect's opinion, does not satisfy the requirements of the Contract Documents.
3. For exposed-to-view surfaces, blend white portland cement and standard portland cement so that, when dry, patching mortar shall match surrounding color.
4. Compact mortar in place and strike-off slightly higher than surrounding surface.

B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of the Architect. Flush out form tie holes, fill with dry-pack mortar, or precast cement cone plugs secured in place with bonding agent.

1. Correct low and high areas as herein specified.
2. Repair finished surfaces containing defects affecting durability of concrete.
3. Correct high areas in surfaces by grinding after concrete has cured at least 14 days.
4. Correct low areas in surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with patching compound. Finish repaired areas to blend into adjacent concrete.
5. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete.
6. Dampen concrete surfaces in contact with patching concrete and apply bonding compound.
7. Mix patching concrete of same materials to provide concrete of same type or class as original concrete.
8. Place, compact, and finish to blend with adjacent finished concrete.
9. Cure in same manner as adjacent concrete.

C. Additional Repair Methods: Repair methods not specified above may be used, subject to acceptance of the Architect.

3.15 PROTECTION FROM AND REMOVAL OF STAINS

A. Protect concrete structure from rust staining by structural steel members and from other substances during the work.

B. If staining should occur, remove stains and restore concrete to its original color.

C. Remove all dust, dirt, mortar, and other foreign matter which would mar appearance of exposed concrete or prevent bond of applied materials.

1. Use approved methods, to complete satisfaction of the Architect.

3.16 DEFECTIVE CONCRETE AND CORRECTIVE WORK

A. Concrete shall be considered defective unless it is structurally sound, properly finished, and within specified tolerances.

B. Replace, strengthen, or correct defective concrete as directed. This work shall be provided at no additional cost to the Owner. The Architect will have the sole authority to decide whether concrete shall be removed and replaced or repaired.

C. Before final acceptance of the work, neatly repair damaged surfaces, corners of concrete and concrete finish.

D. Where surface repairs are permitted, finish damaged areas to smooth, dense water-tight condition.

E. Where corrective work is unsatisfactory, completely remove such work and replace with new work conforming to specified requirements.

3.17 FIELD QUALITY CONTROL

A. Refer to specification Field Quality Control 03 45 00

B. Prior to the commencement of any work under this Section, and when directed by the Engineer or OAR meet at the Project Site to review installation and coordination procedures. Among other topics, the coordination meeting shall address scheduling, method and sequence of concrete construction, standard of workmanship, material selection, testing and quality control requirements, detailed requirements of design mixes, placement procedures, off-site batching requirements, coordination of the Work with with other trades, preparation of surfaces contiguous with this work, adjacent construction, and interferences, if any. This meeting shall be attended by any and all trades, manufacturer's representatives, and other interested parties whose work will be affected by the execution of the work under this Section, including the following:

1. Architect
2. Appropriate Design Consultant(s)
3. Contractor
4. Concrete Subcontractor
5. Testing Laboratories
6. Ready-mix Concrete Supplier
7. Any other subcontractor and/or material supplier or manufacturer required

C. Sampling and Testing:

1. The following requirements are intended to supplement GOAA’s speciation 01 4529 Structural Testing and Inspection. Where conflict exist specification 01 4529 Structural Testing and Inspection shall govern.

2. Sampling: ASTM C 172. The Contractor’s testing agency will collect samples of fresh concrete to perform tests specified. ASTM C 31 for making test specimens.
3. Testing:
   a. Slump Tests: ASTM C 143. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 10 cubic yards (maximum) of concrete.
   b. Temperature Tests: Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F

and above 80 degrees F) for each batch (minimum) or every 10 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

c. Compressive Strength Tests: For concrete to be placed in walls, slabs or other structural members. ASTM C 39. Make five test cylinders for each set of tests in accordance with ASTM C 31. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Provide concrete cylinders for compressive tests not less than once a day, nor less than once for each 150 cubic yards of concrete, nor less than once for each 5000 square feet of surface area for slabs or walls. If the average strength of the 28-day test cylinders is less than f'c and a maximum of one single cylinder is less than f'c minus 300 psi, take three ASTM C 42 core samples and test. If the average strength of the 28-day test cylinders is less than f'c and two or more cylinders are less than f'c minus 300 psi, take six core samples and test. The Architect will determine if concrete represented by core tests is considered structurally adequate. Locations represented by erratic core strengths shall be retested. Remove concrete not meeting strength criteria and provide new, acceptable concrete. Repair core holes with nonshrink grout.

d. Air Content: ASTM C 173 or ASTM C 231. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

e. Verification of Material Suitability: Prior to manufacture, establish the suitability of any material used in the concrete work, prepare design mixes that will produce concrete of specified compressive strengths, make preliminary tests in accordance with ACI 301, Chapter 3, Paragraph 3.8, Method 1 or Method 2, and submit data certifying that proposed concrete ingredients and proportions will result in concrete mixes meeting specified requirements.

f. Concrete Mix Tests: Separate design mixes are required for each anticipated and/or actual change in mix materials.

g. Identification of Design Mixes: Each design mix shall be fully identified as to its proposed use.

h. Review of Proposed Mix Designs: Proposed mix designs, preliminary testing procedures, and results will be subject to review and approval by the Architect.

i. Additional "Preliminary Tests": Whenever either a change of brand or a change of source for any of the concrete ingredients occurs, additional "preliminary tests" will be required and the cost of these tests shall be at no additional cost.

j. Standard Deviation: The Testing Laboratory will establish an initial standard deviation for the statistical evaluation of concrete for the Project. The standard deviation will be established for the Project on the basis of not less than 30 test results from any one class of concrete. Be fully acquainted with all provisions relative to standard deviation and fully comply with the applicable requirements.

    1) The Testing Laboratory will maintain a moving average for compressive strength based on the 3 latest 28-day test results to check compliance with specification requirements. The figures for the standard deviation and moving average for strength will be kept

continuously up to date by the Testing Laboratory on the Project Site, and reported without delay to the Architect.

2) The Testing Laboratory will maintain a continuous up-to-date log in both graphical and tabulated form for each class of concrete.
3) The Testing Laboratory will maintain a moving average for range of test results for quality control purposes as described in ACI 214, Chapter 4, Paragraphs 4.4 and 4.5, respectively.
4) The standard deviation shall be assumed to be greater than 600 psi unless another value has been determined from current similar tests, or until it may be calculated from the results of 30 or more job tests. The computation is described in ACI 214.

k. Strength Requirements: Concrete will be considered to meet strength requirements of the Specifications when in compliance with ACI 301, Chapter 17, Paragraph 17.2., supplemented and amended as specified herein.
l. Inspection: The testing agency retained by the Owner will perform the following inspections as a minimum:
m. Plant and Field Inspection: Concrete work will be subject to detailed inspection at the plant and in the field.
    1) Do not allow placement of concrete until the following is inspected and all deficiencies have been corrected:
        a) Placement and alignment of forms.
        b) Spacing of reinforcement.
        c) Placement of embedded items such as angles, sleeves, PVC weep holes, waterstops and other structural or nonstructural embedments.
        d) Placement of granular base and vapor barrier.
    2) Verify that concrete placement procedures are followed.
    3) Verify that cold-weather or hot-weather placing procedures of concrete are strictly followed.
    4) Verify that concrete curing procedures are strictly followed.
    5) Verify that forms are not removed before time specified.
    6) Verify that the delivery ticket shall contain the following information:
        a) The strength of the mix of concrete being delivered.
        b) The type of coarse aggregate; lightweight or stone.
        c) The exact time the cement and aggregate were discharged into the delivery truck.
        d) List of admixtures.
        e) Name of supplier.
        f) Name of batching plant and location.
        g) Serial number of ticket.
        h) Truck number and batch number.
        i) Job designation (Contract number and location).
        j) Amount of water added.
        k) Type and brand of cement.
        l) Weight of cement.
        m) Maximum permissible amount of water to be added to the site, if any.
        n) Mix design designation.

o) Signature of a responsible officer or employee of the concrete supplier.

7) If upon reaching the job, ready-mix concrete cannot be placed within the time limits stated, or if the type of concrete delivered is incorrect, the inspector will reject the load for use, and it shall be removed from the Project Site at no additional expense.
8) A record of each such inspection shall be submitted to the Architect, covering the quality and quantity of concrete materials, mixing and placing of concrete, concrete formwork, placing of reinforcing steel, and the general progress of the work.
9) Take prompt action to correct assignable conditions which have resulted in or could result in submission of materials, products, or completed construction which do not conform to the requirements of the Contract Documents.

n. Batch Plant Inspection: At the start of the Project and at least once each month until the completion of concrete work, observe and evaluate the following for compliance with the Contract Documents.
1) Condition of batching equipment.
2) Condition of materials.
3) Type of materials used.
4) Mixing time.
5) Delivery time.
6) Additional pertinent controls; depending on weather, job conditions, and other factors affecting the work.
7) Inspect aggregate stockpiles and storage practices. Check for unacceptable material handling which may cause segregation or contamination within the stockpiles.
8) Inspect trucks used to transport concrete to assure that they are clean and in condition to mix and to deliver a uniform mix.

o. Preparatory Inspection: Preparatory inspection shall be performed before beginning work and, in addition, before beginning each segment of work. Preparatory inspection shall include a review of the Contract Document requirements, the review and approval of drawings and other submittal data, a check to assure that required control testing has been provided, a physical examination to assure that all materials conform to specified requirements, and a check to assure all required preliminary work has been completed.
1) Check materials upon delivery at job site to determine that they are the material referenced in the report of test results or certificates of compliance.
2) Check materials for proper storage to assure adequate protection against damage and deterioration.
3) Check to assure that required inspections and observations are being performed.
4) Review Contract Document requirements with each person involved in performing the work.

p. Initial Inspection: Initial inspections shall be performed as soon as practicable after representative segments of the particular item of work have been accomplished in order to provide visual evidence that the

concrete mix and the hydraulic cement concrete operations are producing the desired results.

1) Check for workmanship. Initial inspection for workmanship shall include installation of the forms; location and fastening of the reinforcement; composition of concrete items; mixing procedures, concrete placement, concrete vibration and, concrete finishing.
2) Check for defective or damaged materials.
3) Assure that damaged and/or defective materials are removed from the site and replaced.
4) Batching and Mixing Operations:
    a) Check mixing time.
    b) Continually check for assurance of complete control over batching and mixing.
    c) Check volumes of material used in mix, mixing time, and other controlling features.
    d) Check moisture content of aggregates frequently. Adjust batch weights inaccordance with variations in moisture content.
    e) Check gradations of aggregates frequently.
    f) Check the freshly mixed concrete to see that uniformity is maintained. Any marked change from normal consistency or appearance indicates something wrong with the batching or the mixing, and the concrete shall not be accepted for placement.
    g) Record rejected batches with reasons for rejection.
    h) Check slump and entrained air content as often as necessary to confirm visual checks.

5) Preplacement Inspection: Check all of the following prior to each placement. Do not permit placing to start until all are satisfactory.
    a) Verify that sufficient quantities of all materials are on hand to permit continuous placement and completion.
    b) Verify location, dimensions, alignment and grade.
    c) Verify that the mud slab has been properly installed.
    d) Verify that excavations are free from frost, ice or mud; moist as required; free from standing or running water.
    e) Check form materials.
    f) Check to see that re-used form materials have been reconditioned as required.
    g) Verify that construction is mortar-tight; smooth; free from offsets and blemishes.
    h) Verify that ties and bracing is adequate to maintain position, shape, and alignment of form.
    i) Verify that temporary spreaders are arranged so as to be easily removable as the concrete rises in the form.
    j) Verify that ties are installed where permitted so that they may be withdrawn or broken off to leave no metal closer than the specified minimum distance from the concrete surface.
    k) Verify that forms have been oiled, wetted, or sealed. Check to see that surplus oil has been removed from forms and that there is no oil on steel reinforcement, on construction joints, or

on other surfaces where bonding is required. Verify that forms are clean prior to placing concrete.

l) Check forms for movement which may occur during placing operations. Verify that measuring devices or reference lines have been set up.

m) Verify that necessary clean-outs have been provided for in the bottom of the forms.

6) Joints:

a) Verify that all joints (expansion, contraction, construction) are located as shown on Contract Drawings or as otherwise approved.

b) Verify that construction joints have been prepared as required. Check requirements for air-water cutting, wet sand-blasting, roughening, wetting, etc.

c) Verify that filler has been installed and securely fastened in expansion joints.

d) Verify that expansion joints are free from irregularities or debris which would interfere with free movement.

e) Verify that all arrangements are in place for sawcutting of joints in the slabs (where specified) within the time indicated in this Specification. If this requires night time work verify that all arrangements of lighting the work area are in place.

f) Check all joints which are intended to allow for expansion or contraction. Reinforcement or other fixed metal shall not be continuous through the joint.

7) Reinforcement:

a) Verify that all reinforcement is in place in accordance with accepted shop drawings. Check bar diameters, bar lengths, lengths of splices, bar-to-bar spacing and clearances.

b) Verify that reinforcement has been cleaned of all loose, flaky, rust and scale, dried concrete, oil, grease or other foreign material which would reduce or prevent bond.

c) Verify that reinforcement is tied and supported securely so that displacement will not occur during concrete placement.

d) Verify that reinforcement spacers, ties, plastic covered chairs, and supports are as specified or approved.

8) Miscellaneous Preparation:

a) Verify that satisfactory arrangements have been made to get concrete into all parts of the placement without segregation, loss of ingredients, formation of air pockets or cold joints, vertical drops in excess of permissible limit, "running" of concrete by means of vibrator, and within the maximum time allowed after mixing.

b) Verify that conveying equipment (i.e., crane, buggies, truck mixers, pumpcrete pipe, etc.) is capable of reaching all parts of the placement.

c) Verify that temporary form openings, tremies, chutes, conveyors or other special equipment have been provided as necessary and approved.

d) Verify that arrangements have been made, and all necessary equipment is on hand and in working order to provide curing and protection (including cold weather protection if needed).
e) Verify that safe access and footing have been provided by means of ladders, platforms, walkways, and stagings.

9) Assure that damaged or defective work is corrected.
10) Note and discuss any deficiencies observed and corrective action to be taken. If corrective action is to be taken, conduct an additional initial inspection to verify that proper adjustments, corrections, or revisions have been made.
11) Assure that accomplishment of corrective action is in accordance with requirements.

q. Follow-Up Inspections: Follow-up inspections shall be performed daily and more frequently as necessary, and shall include continued testing and examinations to assure continued conformance with Contract Document requirements.
1) Conveying and Placing Operations:
a) Check requirements pertaining to placing fresh concrete on concrete which has set.
b) Verify that the time between completion of mixing and placement in final position in the form is within the maximum allowed by the Specifications.
c) Check method of placement in handling of concrete to prevent segregation. Check height concrete is allowed to drop freely and method used to guide concrete into place.
d) Verify that concrete is placed rapidly enough to avoid formation of cold joints.
e) Verify that layers are maintained approximately horizontal and not exceeding specified thickness.
f) Verify that form ties and supports are checked frequently and are adjusted as necessary to prevent or correct movements of the form.
g) Verify that the rate of placement is within safe limits, such that forms will not be overstressed by too-rapid rise of fluid concrete.
h) Verify that each layer of concrete is vibrated until fully consolidated.
i) Do not allow vibration to be overdone to the extent of promoting segregation. Do not allow vibrators to be used to transport concrete in the forms.
j) Check use of hand compaction tools insofar as practicable to assist in obtaining smooth, dense surfaces.
k) Do not allow excessive working of the concrete surface in completing a lift.

r. Removal of Forms:
1) Verify that care is being taken to assure that concrete is sufficiently hard and strong before removal of forms.
2) Check to see that forms used for curing are left in place until expiration of required curing period. Forms shall be tightened and maintained "snug" against concrete surfaces at all times while curing.

3) Verify that spalling, chipping, and gouging of concrete is avoided during the form removal operation.
4) Verify that safety practices are being completely exercised during the form removal.

s. Finishing:
1) Check the type of finish required.
2) Verify that defective areas have been repaired and that fins, forms marks and holes are completely removed immediately upon removal of forms.
3) Check the cleaning of areas to be patched. Have honeycomb and rock pockets been cut back to solid material? Has loose material been removed.
4) Check the requirements for the treatment of areas containing defective concrete.
5) Check for complete curing of patched areas.
6) Check surfaces for specified smoothness tolerances. Require rough areas and high spots to be ground smooth.
7) Check that all work is properly and continuously cured for a minimum total of 14 days.
8) Correct deficiencies in cast-in-place concrete work that inspections have indicated as non-conforming.
9) Perform additional inspections as necessary to reconfirm any non-conformance of original work and to show conformance of corrected work.
10) Do not allow any addition to, or building upon, non-conforming work unless correction can be made without disturbing the continuing work.
11) Verify that damaged or defective work is corrected properly and approved by the Architect.
12) Re-inspect replaced materials to determine conformance with Contract Document requirements.
13) Work accomplished shall be considered satisfactory only when inspections show that all variances have been corrected in an acceptable manner and that the completed work is in conformance with the Contract Documents.
14) If, following submission of inspection results, the Architect finds that such inspection reveals a failure of the work to conform to the requirements of the Contract Documents, the deficiencies shall be corrected in a manner approved by the Architect.
15) The final and governing determination of conformance or non-conformance with the Contract Documents will be made by the Architect based on inspection results and Controlled Inspection documentation after all work of this Section has been fully completed in accordance with the Contract Documents.

3.18 Special Inspections:

A. The inspection agency retained by the owner will perform inspections in accordance with the provisions of the Florida Building Code.

B. The Contractor shall coordinate his operations with the Owners inspection agency to insure that inspections can be completed in a timely fashion.

END OF SECTION 03 30 00

SECTION 03 3001 - CAST-IN-PLACE CONCRETE - PARKING GARAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture proportions, placement procedures, finishes, architectural finishes, and other miscellaneous items related to cast-in-place concrete.

B. Cast-in-place concrete includes project requirements specified herein and on drawings:
   1. Water/cementitious materials ratio: See General Notes on Drawings.
   2. Water Reducing Admixture: See Part 2 Article “Admixtures.”
   3. High strength: See General Notes on Drawings.

C. Work in other Sections related to Cast-in-Place Concrete:
   1. Division 1 Section “Project Management and Coordination.”
   2. Division 1 Section “Quality Control.”
   3. Division 3 Section “Post-Tensioned Concrete (Parking Garage.”
   4. Division 7 Section “Traffic Coatings (Parking Garage).”
   5. Division 7 Section “Water Repellants (Parking Garage).”
   6. Division 7 Section “Expansion Control (Parking Garage).”
   7. Division 7 Section “Concrete Joint Sealants (Parking Garage).”
   8. Division 9 Section “Painting (Parking Garage).”

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans and ground granulated blast-furnace slag.

B. Self-Consolidating Concrete (SCC): Highly flowable, non-segregating concrete that can spread into place, fill the formwork, and encapsulate the reinforcement without any mechanical consolidation.

1.4 ACTION SUBMITTALS

A. Sustainable Design Documentation Submittals: Refer to section 01 8113.14 “Sustainable Design Requirements – LEED V4 BD+C”.
   1. Product Data: Documentation for Leadership Extraction Practices in the following:
      a. Regional/Local Multiplier Compliance
      b. Leadership Extraction Practices for Recycled Content
   2. Product Certificates: Provide the following:
      a. Environmental Product Declarations (EPD’s)

b. Corporate Sustainability Reporting (CSR's)

B. Submit Product data for concrete component materials and other concrete related items, including, but not limited to:
   1. Material Certificates: Signed by Manufacturer that each of the following items complies with requirements:
      a. Cementitious materials and aggregates
      b. Admixtures
      c. Form materials and form-release agents
      d. Steel reinforcement and accessories
      e. Fiber reinforcement
      f. Waterstops
      g. Curing materials
      h. Floor and slab treatments
      i. Bonding agents
      j. Vapor barriers/reducer
      k. Repair materials
   2. Submit certification that curing compound or evaporation reducer, if used, is compatible with sealer specified in Division 7 Section "Water Repellants", traffic topping specified in Division 7 section "Traffic Coatings", sealant specified in Division 7 Sections "Concrete Joint Sealants" and "Architectural Joint Sealants", and expansion joint assemblies specified in Division 7 Section "Expansion Joint Assemblies."
   3. Submit certification that curing compound or evaporation reducer is compatible with pavement markings specified in Division 9.

C. Submit materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

D. Submit evidence of licensure in Florida for professional engineer providing professional services as required for Contractor in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures.
   1. Contractor's responsibilities include formwork, shoring and re-shoring procedures, and other work described in Article "Contractors Professional Design Services", Article "Formwork", and Article "Shores and Re-shores".
   2. Performance and design criteria are shown on the Drawings and in Article "Contractor's Professional Services- Performance and Design Criteria".
   3. Contractor's Professional Engineer shall furnish Owner a Certificate of Professional Liability Insurance in the amounts required per Division 1 of the specifications.
   4. Submit calculations and dimensions for "Nominal Form Width" for linear gap at time of forming or erecting concrete elements bounding the expansion joints in accordance with Drawings and Specification "Expansion Joint Assemblies".

E. Submit concrete mixture proportions to Engineer for each concrete mixture. Submit alternate mixture proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Provide mixture proportions not less than four weeks before placing concrete and not less than one week before pre-installation conference (pre-concrete meeting).
2. Proportion mixtures as defined in ACI 301 Section 4 header “Proportioning,” Mixtures shall be proportioned by party other than Testing Agency responsible for testing Project concrete.
3. Proportion mixtures to minimize effects of thermal and drying shrinkage. See Part 2 heading “Concrete Mixtures” header “Shrinkage” for drying shrinkage limit.
4. Use mixture proportions submission form at end of this Section for each concrete mixture, which identifies the following:
    a. Mixture Proportions Identification and use.
    b. Method used for documentation of required average compressive strength, (ACI 301 Section 4 – *Field test data* or *Trial mixtures*).
    c. Gradation of fine and coarse aggregates.
    d. Proportions of all ingredients including all admixtures added either at time of batching or at job site.
    e. Water/cementitious materials ratio.
    f. Slump, ASTM C143.
    g. Certification of the chloride content of admixtures.
    h. Strength at 4 and 28 days, per ASTM C39. In addition, for post-tensioned concrete provide a strength gain curve with sufficient number of data points from 6 to 96 hours to accurately estimate when the minimum compressive strength for tensioning the concrete will be achieved. See Section “Unbonded Post-Tensioned Concrete.”
    i. Water soluble chloride ion content of concrete: ASTM C 1218.
    j. Rapid Chloride Permeability test results per ASTM C 1202.
    k. Shrinkage (length change), ASTM C157 (modified) for cast-in-place post-tensioned concrete only. See Part 2 heading “Concrete Mixtures” header “Shrinkage” for modifications to ASTM C157.
    l. Certificate of analysis of coal fly ash or processed ultra fine fly ash: Comply with ASTM C618, Class C or F:

F. Testing Agency: Promptly report all field concrete test results to Engineer, Contractor and Concrete Supplier. Include following information:
1. See Article “Quality Assurance.”
2. Density (unit weight) of concrete, ASTM C 138.
3. Slump, ASTM C 143.
4. Slump Flow, ASTM C 1611 (for SCC).
5. Concrete temperature at placement time. ASTM C 1064.
6. Air temperature at placement time.
7. Strength determined in accordance with ASTM C 39.
8. Rapid Chloride Permeability Test of core samples in accordance with ASTM C 1202, as and when directed by Specification or Owner.
9. Shrinkage (length change) of superstructure concrete, ASTM C 157 (modified) for post-tensioned concrete and other concrete as noted on the drawings. Shrinkage shall be equal to or less than 0.04% at 28 days
10. Calcium Nitrite presence in plastic concrete: See Part 3 heading, “Quality Control.”

G. Contractor: Submit grout temperature limitations with grout submittal.

H. Submit current certification of welders.

I. Provide certification that curing compound conforms to requirements of ASTM C 1315.

J. All concrete flatwork finishers on Project shall hold current ACI Concrete Flatwork Finisher certification. Submit certification for each concrete flatwork finisher at Concrete Pre-Installation Conference and obtain Engineer's written acceptance.

K. Submit steel producer's certificates of mill analysis, tensile tests, and bend tests for reinforcing steel. Coordinate with welders and welding procedures.

L. Submit shop drawings for steel reinforcement:
   1. Prepare placing drawings that detail fabrication, bending, and placement of concrete reinforcement. 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. Comply with ACI SP-66, "ACI Detailing Manual." Include special reinforcement required for openings through concrete structures, elevations of all walls and columns with locations of all splices and couplers.
   2. Prepare steel reinforcement placing drawings in coordination with the Work of Section "Unbonded Post-Tensioned Concrete". Review the Unbonded Post-Tensioned Concrete tendon shop drawings to determine placement details and clearances. Notify Engineer of potential interference or conflicts for placing reinforcement and post-tensioning tendons.

M. Resubmittals: Engineer will review each of Contractor's submittals the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Construction Manager and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions.
   1. Make resubmittals in same form and number of copies as initial submittal.
      a. Note date and content of previous submittal.
      b. Note date and content of revision in label or title block and clearly indicate extent of revision.

N. Resubmit submittals until they are marked with approval notation from Engineer's and Construction Manager's action stamp

O. Submit shop drawings for architectural finishes for specific exposed finish concrete surfaces. Show form construction including jointing, special form joint or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.

P. Submit samples of materials as requested by Engineer, including names, sources, and descriptions as follows:
   1. Normal weight aggregates.
   2. Fibrous reinforcement.
   3. Reglets.

4. Waterstops.
5. Vapor retarder.

Q. Submit laboratory test reports for concrete materials and mixtures.

R. Submit Minutes of concrete pre-installation conference.

1.5 CONTRACTOR'S PROFESSIONAL SERVICES - PERFORMANCE AND DESIGN CRITERIA

A. Provide professional services for temporary conditions during construction and portions of the Work required to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Specific requirements and criteria include, but are not limited to the following:
   1. Design, erect, shore, brace, and maintain formwork, according to ACI 301 and ACI 347 to support vertical, lateral, static and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads. The contractor is responsible for layout and design, reviews, approvals, and inspections.
   2. Design formwork, shoring, bracing, and other conditions for structural requirements and stability during construction and until final structure is completed and accepted.
      a. Comply with ACI 347.2 for design, installation, and removal of shoring and reshoring.
      b. Superimposed loads to the concrete structure, slab-on-grade, and soil shall be less than the design loads as shown on Drawings.
      c. Check early-age strength of concrete members against anticipated construction loads. Reduce the load on concrete members at the critical concrete age or change the concrete mixture for accelerated strength gain to avoid distress of concrete members.
      d. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads such that no floor or member would be excessively loaded or would induce tensile stresses in concrete members.
      e. Plan sequence of removal of shores and reshores to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excess stress or deflection.
      f. Consider the effects of post-tensioning sequence for post-tensioned beams and girders. Review post-tensioning design criteria on the drawings and in specification Section "Unbonded Post-tensioned Concrete".

B. Design the "Nominal Form Width" for linear gap at time of forming or erecting concrete elements bounding the expansion joints in accordance with Drawings and Specification Section "Expansion Joint Assemblies".

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualification: An experienced supplier who is experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirement for production facilities and equipment. Manufacturer shall also be certified according to the National Ready Mixed Concrete Association's Certifications of Ready Mixed Concrete Production Facilities.

C. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
   1. ACI 301, "Specifications for Structural Concrete."
   2. ACI 318, "Building Code Requirements for Structural Concrete and Commentary."
   3. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials."
   4. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
   5. Florida Building Commission: FBC, "Florida Building Code."

D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in Florida and who is experienced in providing professional engineering services of the kind indicated. See Article "Contractor's Professional Services Performance and Design Criteria".

E. Materials and installed work may require retesting at any time during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

F. PRE-INSTALLATION CONFERENCE: At least 21 days prior to scheduled start of concrete construction, contractor shall conduct meeting to review proposed mixture proportions and methods and procedures to achieve required concrete quality. Contractor shall send pre-concrete conference agenda to all attendees 14 days prior to scheduled date of conference indicating review requirements. Representatives of each entity directly concerned with cast-in-place concrete shall attend conference, including, but not limited to, the following:
   1. Contractor's superintendent.
   2. Agency (laboratory) responsible for concrete mixture proportions).
   3. Agency (laboratory) responsible for field quality control.
   4. Ready-mixed concrete producer.
   5. Concrete subcontractor.
   6. Primary admixture manufacturers.
   7. Engineer.
   8. Owner's representative.
   9. At the pre-concrete meeting the contractor shall provide a summary of concrete procedures to protect fresh concrete from rain.

   The minutes shall include a statement by the Concrete Contractor indicating that the proposed mixture proportions and placing/finishing/curing techniques can produce the concrete quality required by these specifications.

G. Welders and welding procedures for permanent steel formwork shall conform to requirements or AWS D1.1.

H. Welders and welding procedures shall conform to requirements of AWS D1.4. Except where shown on Drawings, welding of reinforcing steel is prohibited unless accepted by Engineer in writing.

I. Threshold Inspection of steel reinforcement is required in accordance with Florida Building Code, Section 105. Inspections shall be conducted by an inspection agency employed by Owner and approved by Engineer. Inspector shall provide report in approved format to Owner with copy to Engineer and Contractor. Inspection agency has authority to reject reinforcing not meeting Contract Documents. Inspections for all reinforcing steel for conformance to shop drawings and Contract Documents shall be completed prior to concrete placement.

J. Threshold Inspector shall submit following information on Inspection of Reinforcement unless modified in writing by Engineer.
   1. Project name and location.
   2. Contractor's name.
   3. Inspection Agency's name, address, and phone number.
   4. Date and time of inspection.
   5. Inspection Agency technician's name.
   6. Fabricator's name.
   7. Weather data:
      a. Air Temperatures.
      b. Weather.
      c. Wind speed.
   8. Inspection location within structure.
   9. Reinforcement inspection data (including but not limited to):
      a. Bar size, spacing, cover, and grade.
      b. Splices, bends, anchorages, welding.
      c. Support methods and construction sequencing.
   10. Inspection of other items related the concrete pour such as embed anchor bolts and connection plates, sleeves and openings or other items related to the structure. Refer to the Threshold Inspection Notes on the drawings.
   11. Diary of general progress of Work.

K. Owner's or Contractors Testing Agency Qualifications:
   1. Independent agency, acceptable to engineer, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   2. Testing laboratory shall submit documented proof of ability to perform required tests.
   3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 4, according to ACI CP-1 or an equivalent certification program.

L. Owner's or Contractors Testing Agency is responsible for conducting, monitoring and reporting results of all tests required under this Section. Testing Agency shall immediately report test results showing properties that do not conform to Project Specification requirements to General Contractor's authorized on-site representative and to Owner's authorized on-site representative.

M. Both Owner's and Contractors Testing Agency shall submit following Field Test information for Project Concrete unless modified in writing by Engineer:

1. Project name and location.
2. Contractor's name.
3. Testing Agency's name, address, and phone number.
4. Concrete supplier.
5. Date of report.
6. Testing Agency technician's name (sampling and testing).
7. Placement location within structure.
8. Time of batching.
9. Time of testing.
10. Elapsed time from batching at plant to discharge from truck at site.
11. Concrete mixture data (quantity and type):
    a. Cement.
    b. Fine aggregates.
    c. Coarse aggregates.
    d. Water.
    e. Water-reducing admixture and high-range water-reducing admixture.
    f. Other admixtures, including supplementary cementitious materials.
12. Weather data:
    a. Air temperatures.
    b. Weather.
    c. Wind speed.
13. Field test data:
    a. Date, time and place of test.
    b. Slump.
    c. Concrete Temperature.
    d. Slump flow (for SCC).
    e. Water content.
    f. Density (Unit weight).
14. Compressive test data:
    a. Cylinder number.
    b. Age of concrete when tested.
    c. Date and time of cylinder test.
    d. Curing time (field and lab).
    e. Cross-sectional area of cylinder.
    f. Compressive strength.
    g. Type of failure (at break).
    h. Rapid chloride permeability test results.

N. Mockups: Before casting concrete, build mockups to verify selections made under sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build two acceptable test panels approximately 600 sq. ft. for flatwork in parking drive areas slab-on-grade in the location indicated or, if not indicated, submit a request for acceptance of the proposed location at the project site. See additional requirements for test panels in specification article "Finishing Floors and Slabs."
2. Build panel approximately 100 sq. ft. for Smooth Form Finish - formed surface in the location indicated or, if not indicated, submit a request for acceptance of the proposed location at the project site.

a. Submit a request for acceptance of the proposed location for concrete ceilings.
b. Submit a request for acceptance of the proposed location for typical interior walls.

3. Build mockups of typical exterior wall of cast-in-place concrete as shown on Drawings.
4. Stains, bugholes or other surface blemishes that deviate from the mockup will not be acceptable.
5. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
6. In presence of Engineer, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
7. Obtain Engineer's acceptance of mockups before casting concrete with specified finishes.

O. Coal fly ash and processed ultrafine fly ash supplier shall make available qualified individual, experienced in placement of fly ash concrete, to aid Contractor. Qualification of supplier’s representative shall be acceptable to Owner. Representative shall attend pre-construction meeting, and shall be present for all trial placements, initial startup and then as required by Owner.

P. At all times during high-evaporation conditions, maintain adequate supply of evaporation reducer at site. Do not use evaporation reducer as finishing aid. See Part 3.

Q. Testing Agency: Identify those trucks of concrete supplier’s which meet requirements of NRMCA Quality Control Manual. Permit only those trucks to deliver concrete to Project.

1.7 REFERENCES

The following publications listed below form a part of this Specification to the extent referenced.

A. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO, “Standard Specifications for Highway Bridges.”
2. AASHTO T 318, “Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.”

B. American Concrete Institute (ACI):
1. ACI 214R, “Evaluation of Strength Test Results of Concrete.”
2. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
3. ACI 305R, “Hot Weather Concreting.”
4. ACI 306.1, “Cold Weather Concreting.”
5. ACI 308R, “Guide to Curing Concrete.”
6. ACI 308.1, “Standard Specifications for Curing Concrete.”
7. ACI 347, “Guide to Formwork for Concrete.”
8. ACI 347.2 “Guide to Shoring/Reshoring of Concrete Multistory Buildings.”
9. ACI 362.1, “Guide for the Design of Durable Parking Structures.”
10. ACI SP15, “Field Reference Manual.”

C. American Iron and Steel Institute (AISI):
   1. AISI, “Specification for the Design of Cold-Formed Steel Structural Members.”

D. American Society for Testing and Materials (ASTM):
   1. ASTM A 36, “Standard Specification for Carbon Structural Steel.”
   2. ASTM A 185, “Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement.”
   3. ASTM A 497, “Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete Reinforcement.”
   4. ASTM A 615, “Standard Specification for Deformed and Plain Carbon -Steel Bars for Concrete Reinforcement.”
   5. ASTM A 706, “Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.”
   6. ASTM B 633, “Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.”
   7. ASTM C 31, “Standard Practice of Making and Curing Concrete Test Specimens in the Field.”
   8. ASTM C 33, “Standard Specification for Concrete Aggregates.”
   9. ASTM C 39, “Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.”
   10. ASTM C 94, “Standard Specification for Ready-Mixed Concrete.”
   11. ASTM C 109, “Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).”
   12. ASTM C 138, “Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.”
   13. ASTM C 143, “Standard Test Method for Slump of Hydraulic Cement Concrete.”
   14. ASTM C 150, “Standard Specification for Portland Cement.”
   15. ASTM C 157, “Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.”
   16. ASTM C 171, “Standard Specification for Sheet Materials for Curing Concrete.”
   17. ASTM C 172, “Standard Practice for Sampling Freshly Mixed Concrete.”
   18. ASTM C 173, “Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.”
   19. ASTM C 231, “Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.”
   20. ASTM C 260, “Standard Specification for Air-Entraining Admixtures for Concrete.”
   21. ASTM C 309, “Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.”
   22. ASTM C 311, “Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.”
   23. ASTM C 330, “Standard Specification for Lightweight Aggregates for Structural Concrete.”
   24. ASTM C 457, “Standard Test Method for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete.”
   25. ASTM C 494, “Standard Specifications for Chemical Admixtures for Concrete.”
   26. ASTM C 567, “Standard Test Method for Determining the Density of Structural Lightweight Concrete.”
   27. ASTM C 595, “Standard Specification for Blended Hydraulic Cements.”

28. ASTM C 618, “Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.”
29. ASTM C 666, “Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.”
30. ASTM C 672, “Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.”
31. ASTM C 989, “Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.”
32. ASTM C 1064/C 1064M “Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.”
33. ASTM C 1077, “Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.”
34. ASTM C 1116, “Standard Specification for Fiber-Reinforced Concrete and Shotcrete.”
35. ASTM C 1202, “Standard Test Method for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration.”
36. ASTM C 1218, “Standard Test Method for Water Soluble Chloride Ion in Mortar and Concrete.”
37. ASTM C 1240, “Standard Specification for Silica Fume Used in Cementitious Mixtures.”
38. ASTM C 1260, “Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method).”
39. ASTM C 1293, “Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.”
40. ASTM C 1315, “Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.”
41. ASTM C 1567, “Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerate Mortar Bar Method).”
42. ASTM C 1602/C 1602M, “Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.”
43. ASTM C 1610/C 1610M, “Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique.”
44. ASTM C 1611/C 1611M, “Standard Test Method for Slump Flow of Self-Consolidating Concrete.”
45. ASTM C 1621/C 1621M, “Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring.”
46. ASTM D 448, “Standard Classification for Sizes of Aggregate for Road and Bridge Construction.”
47. ASTM E 96/E 96M, “Standard Test Methods for Water Vapor Transmission of Materials.”
48. ASTM E 1643, “Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.”
49. ASTM E 1745 “Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.”
50. ASTM F1637 02, “Standard Practice for Safe Walking Surfaces.”

E. American Welding Society (AWS):
   1. AWS D1.1, “Structural Welding Code-Steel.”
   2. AWS D1.4, “Structural Welding Code-Reinforcing Steel.”

F. US Army Corps of Engineers (CE):
1. CE CRD-C 513 “Specifications for Rubber Waterstops.”
2. CE CRD-C 572 “Specifications for Polyvinyl Chloride Waterstops.”
3. CE CRD-C 662 “Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar Bar Method.”

G. Contractor shall have following ACI publications at Project construction site:
1. ACI SP-15, “Field Reference Manual: Standard Specifications for Structural Concrete ACI 301 with selected ACI References.”
2. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
3. ACI 305R, “Hot Weather Concreting.”
4. ACI 306.1, “Cold Weather Concreting.”

H. Accessibility Requirements:
1. “Americans with Disabilities - Act Accessibility Guidelines for Buildings and Facilities”, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111, 1-800-872-2253, http://www.access-board.gov/adaag/ADAAG.pdf

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store all formwork and formwork materials clear of ground, protected, to preclude damage.

B. Deliver reinforcement to Project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

C. Store concrete reinforcement materials at site to prevent damage and accumulation of dirt or excessive rust.

D. Concrete transported by truck mixer or agitator shall be completely discharged within one and one half-hours (one hour for hot weather concreting) after water has been added to cement or cement has been added to aggregates. Schedule deliveries to allow for delays due to weather, traffic, etc.

PART 2 - PRODUCTS

2.1 FORM 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. 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.

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 Textured Finish Concrete: Unit of face design, size, arrangement, and configuration to match control sample. Provide solid backing and form supports to ensure stability of textured form liners.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
1. Products include all corrugated cardboard void forms that temporarily support concrete walls, grade beams, structural concrete slabs and top portion of concrete piers; includes filling the circular section where required.
a. Related accessory products include seam caps, end caps and protective cover boards or any other product to maintain above general products.
b. Submit all product data and manufacturer’s installation instructions under provisions of this Section, based on the design loads specified in contract documents and depth and width indicated.

F. Form Coatings: Provide commercial formulation form-coating compounds with a maximum VOC of 350 grams/liter that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces, including but not limited to water-curing, curing compound, stains or paints.

G. Form Ties: Factory - fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1.5 in. to exposed surface.
1. Provide ties that, when removed, will leave holes not larger than 1 in. diameter in concrete surface.

H. Chamfer strips: Wood, metal, PVC, or rubber strips. 0.75 in. by 0.75 in. min. unless noted otherwise.

I. Nails for P-T Anchors: Stainless steel ring shank nails.
1. Clendenin Brothers, Baltimore, MD.
2. Or Equal.

2.2 STEEL REINFORCEMENT

A. Provide in Bid 20 additional tons of placed reinforcement bars or welded wire reinforcement for inclusion in Project as Engineer directs. Return cost of unused portion to Owner. Submit to Engineer breakdown of use each month.

B. Reinforcement Bars: ASTM A 615, deformed, yield strength: as noted on Drawings.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

D. Post-tensioned Reinforcement: See Section “Unbonded Post-Tensioned Concrete.”

E. Steel Bar Mats: ASTM A 184, assembled with clips.
   1. Steel Reinforcement: ASTM A 615, Grade 60, deformed bars.

F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
   1. Welded wire reinforcement: provide in mats only. Roll stock prohibited.

G. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.

2.3 REINFORCEMENT ACCESSORIES

A. Bar supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports according to CRSI’s “Manual of Standard Practice” from all plastic of greater compressive strength than concrete, and as follows:
   1. In manner acceptable to Engineer solely, bar and welded wire reinforcement supports shall be color-coded to visually differentiate supports by height and shall be fabricated to resist overturning during construction operations.
   2. For slabs on ground, use all-plastic supports with sand plates or horizontal runners where base materials will not support chair legs. All supports shall have sufficient surface area in contact with ground so that they shall not allow clearance loss when reinforcement installed or concrete placed.
   3. For concrete surfaces exposed to view where bar supports contact forms, supports shall have minimal contact, shall not cause voids and shall not cause damage to surrounding concrete. Use all-plastic supports conforming to CRSI Class 1 protection requirements.
   4. Chairs shall be sized and spaced to prevent cover loss during construction operations.
   5. Acceptable manufacturers:
      a. Aztec Concrete Accessories, Inc.
      b. General Technologies, Inc.
      c. Accepted equivalent.
   6. For welded wire reinforcement, provide continuous bar supports spaced at 2 feet o.c., maximum.”

B. For mechanical tension splices of reinforcement:
   1. All splices to develop 125 percent of specified yield strength of bars, or of smaller bar in transition splices. Acceptable products:
      a. Bar-Lock Rebar Coupler, by Dayton Superior.
      b. Bar-Grip or Grip-Twist, by Barsplice Products, Inc.
      c. Extender Coupler, by Headed Reinforcement.
      d. Splice Sleeve, by NMB.
      e. LENTON Splices, by Erico.

C. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.

2.4 CONCRETE MATERIALS

A. Ready Mixed Concrete: Obtain concrete from plant with current certification from:
   1. Concrete Materials Engineering Council.
   2. Florida Department of Transportation.
   3. National Ready Mixed Concrete Association.

B. Portland Cement (ACI 301, Section 4 header “Cementitious Materials”):
   1. Portland cement, Type I, ASTM C 150. Use one cement supplier throughout project. No change in brand or supplier without prior written acceptance from Engineer.
   2. Blended cement, ASTM C 595, Type IP only with prior written acceptance from Engineer.

C. Coal Fly Ash:
   1. Permitted in all parts of structure.
   2. ASTM C 618, Class C or F.
   3. Testing: ASTM C311.
   4. Percentage of fly ash in Mixture Proportion shall be by weight, not by volume. Water/cement ratio will be calculated as water/cementitious (total cement and fly ash) ratio.
   5. If project contains post-tensioned members, see Section “Unbonded Post-Tensioned Concrete,” for high early strength requirements for concrete to be post-tensioned.
   6. Prohibited: Fly ash in same mix with Type IP blended cement.
   7. If strength or air content varies from value specified by more than specified tolerances, Engineer or designated representative shall reject that concrete.
   8. Submit all fly ash concrete Mixture Proportions per ACI 301.

D. Slag – (Ground Granulated Blast-Furnace Slag – GG-BFS):
   1. ASTM C 989, Grade 100 or higher.
   2. Percentage of GGBF slag in Mixture Proportion shall be by weight, not by volume. Water-cement ratio shall be calculated as water-cementitious (total portland cement + GGBF slag) ratio.
   3. If strength or air content varies from value specified by more than specified tolerances, Engineer or designated representative shall reject that concrete.
   4. Submit all GGBF slag concrete mixture proportions per ACI 301.

E. Normal Weight Aggregates (ACI 301, Section 4 header “Aggregates”):
   1. Normal weight concrete aggregates:
      a. Coarse aggregate: Crushed and graded limestone or approved equivalent conforming to ASTM C33 except as noted here, minimum class designations as listed below:
         1) Below grade construction and below frost line: Class 1N.
         2) Walls not exposed to public view: Class 1N.
         3) Walls exposed to public view: Class 1N.
         4) Slabs on ground: Class 1N.
         5) All other concrete: Class 1N.

b. No deleterious materials such as, but not limited to, chert or opaline.
c. Fine aggregate: Natural or Manufactured sand conforming to ASTM C 33 and having preferred grading shown for normal weight aggregate in ACI 302.1R, Table 5.1.
d. Coarse Aggregate shall not contain crushed hydraulic-cement concrete.

2. Coarse aggregate: Nominal maximum sizes indicated below, conforming to ASTM C 33, Table 2:

a. Footings/Foundations: Size number 57 or 357.
b. Slab on grade: Size number 57.
c. All other members: Size number 67.

3. Chloride Ion Level: ASTM C 1218. Chloride ion content of cement, aggregates and all other ingredients: tested by laboratory making trial mixes.

F. Water: Comply with ASTM C 1602.

G. Storage of Materials (ACI 301, Section 4 header “Materials Storage and Handling”).

2.5 ADMIXTURES

A. Use water-reducing admixture, mid-range water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete as required for placement and workability.

B. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg. F as required for schedule.

C. Use high-range water-reducing admixture (HRWR) in pumped concrete, and for concrete with water/cementitious ratio of less than or equal to 0.45. Use high-range or mid-range water-reducing admixtures in pumped concrete and normal or mid-range water reducing admixtures for concrete with water/cementitious ratios greater than 0.45.

D. Self-consolidating concrete (SCC) may be used where placement due to either dense reinforcement or form design requires both a high level of workability (horizontal slump flow greater than 24 in. diameter) and the water/cementitious ratio is less than or equal to 0.45.

E. Only admixture manufacturers listed acceptable. Do not submit alternate manufacturers.

F. Concrete supplier and manufacturer shall verify via trial mixes and certify compatibility (no adverse effect on workability, strength, durability, entrained air content, etc.) of all ingredients in each Mixture. Use admixtures in strict accordance with manufacturer’s recommendations.

G. Prohibited Admixtures: Calcium chloride or admixtures containing intentionally added chlorides shall not be used.

H. Normal Water-Reducing Admixture: ASTM C 494, Type A.
1. Products: Subject to compliance with requirements, provide one of following:

a. “Eucon Series,” Euclid Chemical Co.
b. “WRDA Series,” GCP Applied Technoligies (Grace)
c. “Pozzolith Series,” or “PolyHeed Series,” BASF Construction Chemicals.
d. “Plastocrete Series”, Sika Corporation.

I. Mid Range Water-Reducing Admixture: ASTM C 494, Type A.
1. Subject to compliance with requirements, provide one of following:
a. “Eucon MR” or “Eucon X-15 and X-20,” Euclid Chemical Co.
b. “Daracem Series” or “MIRA Series,” GCP Applied Technoligies (Grace)
c. “PolyHeed Series,” BASF Construction Chemicals.
d. “”Sikaplast Series” or “Plastocrete Series”, Sika Corporation.
e. “Catexol 2000 NI,” Axim Concrete Technologies.
f. “Polychem 1000” or “KB Series,” General Resource Technology.
g. “Finishease-NC,” Russ Tech Admixtures, Inc.

J. High Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F.
1. Products: Subject to compliance with requirements, provide one of following:
a. “Eucon 37” or “Eucon SP-Series” or “Plastol Series,” Euclid Chemical Co.
b. “Daracem Series” or “ADVA Series,” GCP Applied Technoligies (Grace)
c. “Rheobuild 1000”, “PS 1466” or “Glenium Series,” BASF Construction Chemicals.
d. “Sikament Series” or “Sika ViscoCrete Series,” Sika Corporation.
e. “Catexol 1000 SP-MN,” Axim Concrete Technologies.
f. “Melchem Series,” General Resource Technology.
g. “Superflo 443” or “Superflo 2000 Series,” Russ Tech Admixtures, Inc.

K. High-Range Water-Reducing Admixture (Superplasticizer) for Self-Consolidating Concrete, ASTM C 494 Type F.

1. Products: Subject to compliance with requirements, provide one of the following:
a. “Plastol Series” or “Eucon SPC or SPJ,” Euclid Chemical Co.
b. “ADVA Series,” GCP Applied Technoligies (Grace)
c. “Glenium Series” or “PS1466,” BASF Construction Chemicals.
d. “Sika ViscoCrete Series” or “Sikament Series”, Sika Corporation.

L. Viscosity Modifying Admixture for Self-consolidating Concrete:
1. Products: Subject to compliance with requirements, provide one of the following:
a. “Visctrol” or “Eucon ABS,” Euclid Chemical Co.
b. “Rheomac VMA Series,” BASF Construction Chemicals.
c. “Sika Stabilizer Series,” Sika Corporation.

M. High Range water reducing retarding (superplasticizer), ASTM C 494 Type G:
1. Products: Subject to compliance with requirements, provide one of following:
a. “Eucon 537 or RD2,” Euclid Chemical Co.
b. “Daracem 100,” GCP Applied Technoligies (Grace)

N. Non-Chloride, Non-Corrosive Water-Reducing, Accelerating Admixture: ASTM C 494, Type C or E.
1. Products: Subject to compliance with requirements, provide one of following:

a. “Eucon AcN-Series,” “Accelguard 80,” “Accelguard NCA,” or “Accelguard 90,” Euclid Chemical Co.
b. “DCI,” “PolaraSet,” “Lubricon NCA,” or “Gilco,” GCP Applied Technoligies (Grace)
c. “Pozzutec 20+” or “Pozzolith NC 534,” BASF Construction Chemicals.
d. “Sika Set NC,” “Plastocrete 161FL”, or “Sika Rapid-1,” Sika Corporation.
e. “Catexol 2000 RHE,” Axim Concrete Technologies.

O. Water-Reducing or retarding Admixture: ASTM C 494, Type D or B.
1. Products: Subject to compliance with requirements, provide one of following:
a. “Eucon Retarder-75”, “Eucon DS” or “Eucon W.O.” Euclid Chemical Co.
b. “Daratard-17” or “Recover,” GCP Applied Technoligies (Grace)
c. “Pozzolith Series” or “Delvo Series,” BASF Construction Chemicals.
d. “Sikatard Series,” or “Plastiment Series” or “Plastocrete Series,” Sika Corporation.
2. Products:
a. “ASRx 30LN,” BASF Construction Chemicals.
b. “Eucon Integral ARC,” Euclid Chemical Co.
c. “Sika Control ASR”, Sika Corporation.
d. “Rasir,” GCP Applied Technoligies (Grace)
3. Include water content in admixture when calculating water-to-cement ratio.
4. Provide satisfactory CE CRD-C667 results with lithium admixture as defined in “Alkali-Aggregate Reactivity Resistance” paragraph below.

P. Shrinkage Reducing Admixture:
1. Design requires using materials with combined drying shrinkage characteristic of 0.04 percent maximum at 28 days. Proposed concrete Mixture(s), using actual aggregates, admixtures and cement of the proposed mix for Project as detailed herein and in Drawings, shall meet criteria. Submit ASTM C 157 (may be modified by curing period duration) results for at least 3 specimens. Test takes 28 days minimum. Begin tests as soon as possible so final test results available for submittal to Engineer.
2. Products: Subject to compliance with requirements, provide one of following:
a. If calcium nitrite is present in the original concrete mixture:
1) “Eclipse 4500,” GCP Applied Technoligies (Grace)
2) “Eucon SRA +” Euclid Chemical Company.
3) “Sika Control 40”, Sika Corporation.
b. If calcium nitrite is not present in the original concrete mixture:
1) “Eucon SRA,” or “Eucon SRA+,” Euclid Chemical Company.
2) “Eclipse Plus,” GCP Applied Technoligies (Grace)
3) “Tetraguard AS 20,” BASF Construction Chemicals.
4) “Sika Control 40,” Sika Corporation.
5) “SRA-157, “Russ Tech Admixtures, Inc.

2.6 FIBER REINFORCEMENT:

A. Polypropylene fibers for plastic shrinkage control in concrete members.
1. Products: Subject to compliance with requirements, provide one of the following:
a. “Fiberstrand 100,” Euclid Chemical Co.

b. “Mighty-Mono,” Forta Corp.
c. “Polymesh,” General Resource Technology.
d. “Gilco,” or “Grace Fibers,” or “Grace Microfibers,” GCP Applied Technoligies (Grace), Inc.
e. “Durafiber,” Industrial Systems, Ltd.
f. “MasterFiber F or M Series,” BASF Construction Chemicals.
g. “Fibermesh 150,” Propex Concrete Systems.
h. “Sika Fibers,” or “Sika Microfibers,” Sika Corporation.

2. Additional requirements:
   a. Collated fibrillated materials: Dosage rate 1.0 lb/cu. yd. of concrete minimum, containing at least 3 million individual fibers.
   b. Multifilament (microfilament) fibers: Dosage rate 0.5 lb/cu. yd. of concrete minimum, containing at least 25 million individual fibers. Minimum length 0.75 in.
   c. Meet requirements of ASTM C 1116, “Standard Specification for Fiber-Reinforced Concrete and Shotcrete,” designation Type III,
   d. Meet minimum plastic shrinkage crack reduction of 70 percent when tested in accordance with ICBO ES, Appendix B (7-92).

B. Use shall not change water requirement of mix. Slump loss due to addition of fiber shall be offset by addition of superplasticizer.

C. Conform to manufacturer’s recommendations for quantity of fiber. See paragraph “Additional Requirements” above for minimums.

D. See Drawings for locations of allowable use.

E. Fiber manufacturer or approved distributor: Provide services of qualified representative at pre-construction meeting, concrete pre-installation meeting and first concrete placement containing fibers.

2.7 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: Flat, dumbbell without center bulb.

B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: Flat, dumbbell without center bulb.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Rubber Waterstops:
      a. Greenstreak.
      b. Progress Unlimited Inc.
      c. Williams Products, Inc.
   2. PVC Waterstops:
      a. Greenstreak.

b. Meadows: W.R. Meadows, Inc.
c. Progress Unlimited Inc.
d. Sternson Group.

D. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Superstop; Tremco Inc.
b. Volclay Waterstop-RX; Colloid Environmental Technologies Co.
c. Hydrotite; Greenstreak.
d. Mirastop; Miradri, Div. Of Royal Ten Cate (USA), Inc.
e. Superstop; Progress Unlimited Inc.
f. SikaSwell Profile; Sika Corporation.

2.8 VAPOR BARRIERS

A. Vapor Barrier: Provide vapor barrier which conforms to ASTM E 1745, Class A. The membrane shall have a water-vapor transmission rate less than or equal to 0.008 gr./ft^2/hr when tested, in accordance with ASTM E96. Vapor barrier shall be no less than 15 mils thick. The vapor barrier shall be placed over prepared base material where indicated below slabs on ground.
1. New ISO certified virgin resins, polyolefin based maximum.
2. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to “Griffolyn Vaporguard” by Reef Industries, Inc., Stego Wrap (15-Mil) Vapor Barrier by Stego Industries LLC, or Perminator (15 Mil) Underground Vapor Barrier by W.R. Meadows,.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.9 CURING MATERIALS

A. Evaporation Reducer: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Evaporation Retarder:
a. Cimfilm; Axim Concrete Technologies.
b. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
c. Eucobar; Euclid Chemical Co.
d. E-Con; L&M Construction Chemicals, Inc.
e. Confilm; BASF Construction Chemicals, LLC.
f. SikaFilm; Sika Corporation.
g. Sure-Film (J-74); Dayton Superior Corporation.
h. “EVRT”, Russ Tech Admixtures, Inc.

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

C. Moisture-Retaining Cover: Polyethylene coated burlap comprised of a minimum 4 mil polyethylene extruded onto 10- ounce burlap with components complying with AASHTO M171, AASHTO M182 Class II and ASTM C-171. The cover shall be suitable for multiple uses. Acceptable products:
   1. Hydracure M5 by Hydracure Covers
   2. Bur Lene by Max Katz Bag Co. Inc
   3. Curelap-Poly Coated Burlap by Midwest Canvas Corp.
   4. UltraCure DOT by Sika Corporation..

C. Water: Potable.

D. Curing Compound (VOC Compliant, less than 350 g/l): Comply with ASTM C 309, Type 1, Class A or B. Moisture loss shall be not more than 0.55 kg/m^2 when applied at 200 sq. ft/gal. Manufacturer's certification is required. Silicate based compounds prohibited.
   1. Subject to project requirements provide one of the following products:
      a. "Kurez DR VOX" or "Kurez RC," or "Kurez RC Off," Euclid Chemical Company.
      b. "RxCure WB," or "RxCure VOC" or "W.B. Cure VOC," Conspec Marketing & Manufacturing.
      c. "Kure N Seal W" or "Kure N Seal WB" BASF Construction Chemicals, LLC.
   2. Additional requirements:
      a. With product submittal provide plan and procedures for removal of residual curing compound prior to application of sealers, coatings, stains, pavement markings and other finishes.
      b. Provide a summary of testing to show adequate surface preparation for successful application of sealers, coatings, stains, pavement markings, and other finishes.

2.10 RELATED MATERIALS

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

B. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
   1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
   2. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

C. Reglets: Fabricate reglets of not less than 0.0217-inch- thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

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

E. Mechanical and chemical anchors as specified on the drawings or used for attaching supports for miscellaneous electrical, plumbing and mechanical components along with repairs for missing embeded anchor bolts shall be manufactured by Hilti Fastening Systems, Tulsa Oklahoma, ITW Ramset/Red Head, Wood Dale, IL, Simpson Anchor Systems, Columbus, OH, Powers Fasteners, Brewster, NY, SimpsonStrong-Tie Co., Inc., Pleasanton, CA, Powers Fasteners, Brewster, NY, or accepted equivalent. Anchor bolt composition shall be from one or more of carbon steel and stainless steel, lead, Zamac alloy, nylon, plastic, polypropylene, and jute fiber.
   1. Strength of all anchors shall comply with ICC-ES-AC 193 or ICC-ES AC308 and ACI 318-11 Appendix D.
   2. Carbon steel anchors shall be either zinc plated in accordance with ASTM B 633, or hot-dipped galvanized in accordance with ASTM A-153-78. Provide mill test reports and manufacturer's quality control certification upon Engineer's request.
   3. Stainless steel anchors shall be manufactured from ASTM A304, or A663 stainless steel. Provide mill test reports and manufacturer's quality control certification upon Engineer's request.
   4. Plastic, lead, or Zamac alloy anchors shall not be used for overhead applications Chemical anchors shall not be used to resist pullout forces in overhead and wall installations unless proper consideration is given to fire conditions. For chemical anchors, consult with manufacturer's engineer.
   5. Safety Factors: Static load safety factors shall be per manufacturer's published data. Critical load (vibratory, overhead, etc. or more) safety factors shall be 10:1 minimum. Chemical anchors are not permitted for critical loads and where resistance to direct sustained tension is required.
      a. If necessary for purposes of determining tensile and/or shear capacity in questionable base material, testing shall be done prior to actual anchor installation. Proof load, load duration and ASTM procedures will be provided for the testing procedure. A maximum of five tension and/or shear tests shall be performed by manufacturer's engineer. Anchors shall be proof loaded in tension and/or shear to assure that working load capacity is within specified allowable load limit as published by manufacturer.
   6. Anchor spacing and edge distance per manufacturer's limits. Loading and cluster spacing shall be as established by minimum industry standards for anchors, except as follows: Anchor loading, cluster spacing and edge distances shall be as published in manufacturer's literature. Consult with manufacturer's engineer for specific requirements.
   7. Anchor installation shall be as required by manufacturers written instructions.
   8. Refer to the general notes for additional information on "Post-Installed Anchors".

F. Inserts and Coil Rods:
   1. Yield strength: 65,000 psi minimum.
   2. Galvanizing: Where indicated, electrodeposited zinc coating, ASTM B 633, Service condition 1, Type III.
   3. Acceptable manufacturers:
      a. Dayton/Richmond Concrete Accessories, Inc., Miamisburg, OH.
   4. Details shown on drawings are based on Dayton/Richmond Concrete Accessories, Inc. products and their respective capacities. Other products may

be used only if contractor submits calculations, sealed by professional engineer or structural engineer licensed in Florida, substantiating strength of connection with other product. Calculations are subject to Engineer's acceptance before fabrication is to proceed.

G. Joint Filler:
1. Joint filler in slabs and curbs: Asphalt impregnated fiber board; as shown on Drawings. Acceptable products:
a. "Flexcell," Knight-Celotex Corp.
b. "Fibre Expansion Joint," W.R. Meadows, Inc.
2. Joint filler used vertically to isolate walls from columns or other walls: White molded polystyrene beadboard type.
3. Joint cover used to bridge gap between columns and grade walls, retaining walls, or basement walls: Minimum width: Gap width plus 4 in. For gaps over 3 in. wide, protect cover with protection board sized to span gap satisfactorily. Acceptable products:
a. "Sealtight Melgard," W.R. Meadows, Inc., Elgin, Illinois and shall be applied according to manufacturer's instructions.
b. Acceptable substitute.

H. Slide Bearing System at Expansion Joints:
1. Provide slide bearing system as shown and detailed on Drawings:
a. Beam and double tee bearings shall be reinforced PTFE: 100 percent virgin tetrafluoroethylene polymer and ground glass fiber reinforcing aggregate, prebonded to stainless steel and/or preformed fabric (Section "Plant Precast Structural Concrete," Part 2 Article "Materials," paragraph "Bearing Pads") bearing pads. Acceptable slide bearing systems:
1) "Fluorogold," Seismic Energy Products, L.P. Pine Brook, New Jersey.
2) "Balco," Balco, Inc., Wichita, Kansas.
3) "Alert 15175 Shock Pads with TFE," Alert Manufacturing and Supply Co. Chicago, Illinois.
4) "Dura-Slide," Tobi Engineering, Inc., Elk Grove Village, Illinois.
5) "Dynalon Slide Bearings with Masticord," JVI, Inc., Skokie Illinois.
b. Slab and plank bearings shall be ultrahigh molecular weight, high-density polyethylene resin: Acceptable material:
1) "Korolath PE," Korolath Corporation, Hudson, Mass.
2) "Tivar-1000," Poly-Hi/Menasha Corporation, Fort Wayne, Indiana.
3) "UHMW Econ-o-Shim," Deslausiers, Inc., Bellwood IL.
2. Backing materials for reinforced PTFE slide bearing systems as shown on Drawings:
a. Galvanized steel.
b. Stainless steel.
c. Reinforced elastomer, having durometer hardness of 90 +/- 5 and meeting requirements of Article 2.10.3(L) of AASHTO Standard Specifications for Highway Bridges (1983).

2.11 REPAIR MATERIALS

A. Acceptable repair materials:

1. Extended Open Time Epoxy Bonding Agent: Three-component, water based, epoxy modified portland cement bonding agent and corrosion inhibitor coating providing the recommended Manufacturer's open time in which to apply repair mortar. Product shall be capable of achieving bond strength of 2,700 psi per ASTM C 882.
   a. "Duralprep A.C.", by The Euclid Chemical Company, Cleveland, OH.
   b. "Emaco P24", by BASFBuilding Systems, Shakopee, MN.
   c. "Sika Armatec 110 EpoCem", by Sika Corporation, Lyndhurst, NJ.
   d. "Planibond 3-C" or "Mapefer 1K", by Mapei Corporation, Deerfield Beach, FL.
2. Epoxy Adhesive: 2 or 3 component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces:
   a. "Euco #452 Epoxy Series", or "Duralcrete Epoxy Series", by The Euclid Chemical Company, Cleveland, OH
   b. "Emaco P24", or "Concresive Liquid LPL", by BASF Building Systems, Shakopee, MN.
   c. "Sikadur 32 Hi-Mod LPL" by Sika Corporation, Lyndhurst, NJ.
3. Trowel Applied Repair Mortar: Shall be prepackaged polymer-modified cementitious repair mortar capable of vertical/overhead application by trowel achieving a minimum 3,000 psi compressive strength at 7 days and 5,000 psi compressive strength at 28 days per ASTM C 109 as certified by manufacturer. All patches shall be squared or rectangular in shape with ½" deep sawcut edges, except at locations of reinforcement or tendons. Minimum repair thickness shall be ½" unless specified greater by the manufacturer and maximum lift thickness according to manufacturer requirements.
   a. "EMACO R Series", "Thorite Rapid Vertical", or HBA or HB2 Repair Mortars", by BASF Building Systems, Shakopee, MN.
   b. "Duraltop Gel", "Speedcrete PM", or "Verticoat", by The Euclid Chemical Comany, Cleveland, OH.
   c. "SikaRepair 223 with Latex R", "SikaRepair SHB with Latex R", or SikaRepair SHA with Latex R", by Sika Corporation, Lyndhurst, NJ.
   d. "Planitop 23" by MAPEI Corporation, Deerfield, FL.
4. Horizontal Repair Mortar: Shall be prepackaged polymer-modified, cementitious repair mortar capable of horizontal, pour and screed, form and pour, partial depth, partial and full depth, or full depth applications. Material shall achieve a minimum 3,000 psi compressive strength at 7 days and 5,000 psi compressive strength at 28 days per ASTM C109 if neat and ASTM C39 if extended as certified by manufacturer. Manufacturer shall submit volume and size of SSD aggregate used for mix extension. All patches shall be squared or rectangular in shape with ½" deep sawcut edges, except at locations of reinforcement or tendons. Minimum thickness shall be ½" and maximum thickness of placement according to manufacturer requirements.
   a. "Duraltop Flowable Mortar", by The Euclid Chemical Company, Cleveland, OH.
   b. "Emaco S66 CI", or "Emaco R310 CI", by BASF Building Systems, Shakopee, MN.
   c. "SikaTop 111 Plus", "Sikatop 122 Plus", or Sika Repair 222 with Latex R", by Sika Corporation, Lyndhurst, NJ.
   d. "LS-S6 or S10" or "LM-S6 or S10", by King Packaged Materials Company, Burlington, ON.

e. "Topcem Premix with Planitop AC", by MAPEI Corporation, Deerfield Beach, FL.

5. Immediate upon conclusion of finishing operation cure concrete in accordance with ACI 308 for duration of at least seven days by moisture curing or moisture retaining covering. Provide additional wet curing immediately following initial curing and as necessary before concrete has dried.
   a. Continue method used in initial curing.
   b. Material conforming to ASTM C171.
   c. Other moisture retaining covering as approved by Engineer.
   d. During initial and final curing periods maintain concrete above 50°.
   e. Prevent rapid drying at end of curing period.

2.12 CONCRETE MIXTURES

A. Proportion mixtures determined by either laboratory trial mix or field test data bases, as follows:
   1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
   2. Provide different mixtures as the season warrants, as well as each type and strength of concrete or for different placing methods.

B. Use a qualified independent testing agency for preparing and reporting proposed Mixture Proportions for the laboratory trial mix basis.

C. Requirements for normal-weight concrete mix are shown on Drawings:
   1. Compressive strength
   2. Slump
   3. Water-cementitious materials ratio

D. Supplementary cementitious materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials according to ACI 318 requirements.

E. Supplementary cementitious materials: Maximum weight of fly ash, natural pozzolans, processed ultrafine fly ash or slag included in concrete shall not exceed percentages of total weight (see footnotes for ACI 301 Part 4 Table "Requirements for Concrete Exposed to Deicing Chemicals") of cementitious materials as follows:
   1. Fly Ash or other pozzolans conforming to ASTM C 618: 25 percent.
   2. Slag conforming to ASTM C 989: 50 percent.
   3. Processed ultra fine fly ash conforming to ASTM C 618: 15 percent.
   4. Total of fly ash or other pozzolans and slag: 50 percent.

F. Chloride Ion Content of Mixture:
   1. Water soluble chloride ion content of concrete shall not exceed 0.06 percent by weight of cement for pre-stressed concrete and 0.15 percent for reinforced concrete. (ACI 318 Chapter 4 Table 4.4.1"Maximum Chloride Ion Content for Corrosion Protection of Reinforcement") Test to determine chloride ion content shall conform to ASTM C 1218.
   2. Concrete chloride ion content shall be determined by Testing Agency prior to placement. Cast samples from current production of concrete mix proposed for superstructure.
   3. Concrete not meeting the requirements of paragraph "Water soluble chloride ion content of concrete…" above, shall contain appropriate amount of calcium

nitrite. Concrete supplier shall provide laboratory test results showing the amount of excess chloride ion content in the concrete mixture contributed by the aggregates. For each pound of chloride ion in excess of the amount allowed, mix shall contain calcium nitrite (30 percent, plus or minus 2 percent, solids content) on one-to-one basis (one gallon of calcium nitrite for one lb of excess chloride ion). Calcium nitrate used to offset chloride ions is in addition to calcium nitrate used as a corrosion inhibitor. Maximum of 1.5 lb of chloride ion per cubic yard may be offset in this manner.

G. Alkali-Aggregate Reactivity Resistance: Provide one of the following:
   1. Total equivalent alkali content of mixture less than 5 lb/cu. yd.
   2. ASTM C1293: Expansion less than 0.04 % after 1 year for each of the aggregates (both coarse and fine) in the proposed concrete mixture. This data shall be less than 1 year old.
   3. ASTM C1260: Expansion less than 0.1 % after 14 days for each of the aggregates (both coarse and fine) in the proposed concrete mixture.
   4. ASTM C1567: Expansion less than 0.1 % after 14 days with each of the aggregates (both coarse and fine) and the supplementary cementing materials (both source and quantity) of the proposed concrete mixture design. Alternatively, if satisfactory ASTM C1260 test results can be provided for one of the aggregates that are being used, ASTM C1567 testing does not need to be provided for that aggregate.
   5. CE CRD-C662: Expansion less than 0.1 % after 28 days with the each of the aggregates (both coarse and fine), the supplementary cementing materials (both source and quantity) of the proposed concrete mixture design and the lithium admixture source and dosage level of the proposed mixture design. Alternatively, if satisfactory ASTM C1260 test results can be provided for one of the aggregates that are being used, CRD-C662 testing does not need to be provided for that aggregate.

H. Synthetic Fiber (collated fibrillated or monofilament): Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1 lb/cu. yd.

I. Admixtures: Use admixtures according to manufacturer's written instructions.

   1. Consider using water-reducing admixture or high-range water-reducing admixture (Superplasticizers), OR admixtures that achieve self-consolidating concrete, as required, for placement, workability, finishing and when required, increased flowability.
   2. Consider using water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use high range water-reducing admixture in pumped concrete, concrete for parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio of 0.45 or less. Use normal or mid-range water reducing admixture for concrete with water-cementitious materials ratio greater than 0.45.

J. Slump (ACI 301, Part 4 header "Slump"):

   1. Maximum slump for concrete is indicated on Drawings. Where field conditions require slump to exceed that shown, increased slump shall be obtained by use of high range water reducers (superplasticizers) only, and Contractor shall

obtain written acceptance from Engineer who may require an adjustment to mix.

2. All concrete containing high-range water-reducing admixture (superplasticizer) shall have a verified initial slump of 2– 3 in. Final slump after the addition of the superplasticizer shall be 6–9 in. as required by the contractor to properly place the concrete. Before permission for plant addition of superplasticizer to be granted by Engineer, fulfill following requirements:

    a. Submit letter from testing laboratory which developed original mixture proportions, for each superplasticized mixture, certifying volume of mix water which will produce specified slump and water/cement ratio, taking into account aggregate moisture content.
    b. Submit plant computer printout of mixture ingredients for each truckload of superplasticized concrete with delivery of that truckload. Mix water volume greater than that certified shall be cause for concrete rejection.
    c. Over-retarding or crusting of flatwork surface: cause for concrete rejection.
    d. Segregation or rapid slump loss (superplasticizer life) due to incompatibility or under-dosing: cause for concrete rejection.

K. Shrinkage (Length Change):

1. Determine length change of hardened concrete test specimens in accordance with ASTM C 157, except as noted in paragraph below. Existing test data from previous project with same materials may be acceptable.
2. Test specimens shall be moist cured, including period in molds for 7 days. Then store specimens in air for period of 28 days.
3. Utilize concrete materials and mix proportions submitted, for use in floor slab beam, in accordance with Part 1 Article “Submittals”.
4. Report length change of specimens after periods of air drying after curing of 4, 7, 14, 21, and 28 days.
5. Average length change after 28 days shall be limited to 0.04%, unless otherwise accepted by Engineer. Values exceeding 0.04% shall be rejected.

L. Self-Consolidating Concrete:

1. Minimum flow of 24 in. to 28 in. or as required by the successful test placement. All self-consolidating concrete shall contain the specified high-range water-reducing admixture and viscosity-modifying admixture as required.
2. Measure slump flow using slump cone upright or inverted in accordance with ASTM C1611. Measured flow shall be greater than 24 inches and consistent with submitted mixture test parameters plus or minus 2 in.
3. Measure passing ability in accordance with ASTM C 1621/C 1621M. Use the slump cone in the same way as in the slump flow test. Difference in average slump flow between slump flow and passing ability tests shall not exceed 2 in.
4. Determine the static segregation (stability) in accordance with ASTM C 1610/C 1610M. Segregation factor of the mixture shall not be more than 15 percent.

M. Engineer’s acceptance of mixture proportions shall not relieve Contractor from responsibility for any variation from requirements of Contract Documents unless Contractor has in writing called Engineer’s attention to each such variation at time of submission and Engineer has given written approval of each such variation.

N. Adjustment to Concrete Mixtures: Adjustments to mixture proportions may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mixture and strength results shall be submitted to and accepted by Engineer before using in work.

2.13 FABRICATING REINFORCEMENT

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

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch plant-printed ticket information at delivery to site.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Provide plant-printed batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mixture identification number, date, time of batching, mixing time, quantity and details of materials, amount of water introduced and water permitted by plant to be added, if any.

C. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, mixture identification number, date, time of batching, mixing time, quantity and details of materials, and amount of water added. Record approximate location of final placement in structure.

2.15 TOOLS

A. Slab Jointing

1. Concrete groovers: For tooled joints in concrete:

a. For concrete not exceeding 4 in. thickness, use groover with 1 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.
b. For concrete exceeding 4 in. thickness, use groover with 1.5 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.

2. Saw Cut Joints:

a. Acceptable tool: “Soff-Cut Saw Model 310” or “Model G2000,” Soff-Cut International, Corona, CA.

1) Cut joint as soon as concrete will support weight of operator and saw without deforming.
2) Joint shall be 1 in. deep for concrete thickness of 4 in. or less. Joint shall be 1.5 in. deep for concrete exceeding 4 in. thickness. Do not cut reinforcement.
3) Extend joint to adjacent vertical surface within 30 minutes of cutting.
4) Retool or grind sawcut joint before installing sealant to provide equivalent dimensions, shape and volume as joint obtained by tooled joint. Surface width shall be 0.5 in. with 3/16 to 1/4 in. edge radius.
5) All joints subject to acceptance by sealant installer. Rework rejected joints until acceptable to sealant installer.

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 concrete structure can support such loads and in accordance with Article 1.5 “Contractor’s Professional Services – Performance and Design Criteria”.

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

1. Drilled Pier Caps and Pile Caps:

a. Variation of center from specified plan location: 0.5 in.
b. Variation of bearing surface from specified location: Plus or minus 0.5 in.
c. Variation from specified dimensions in plan: Plus 2 in. minus 0 in.
d. Variation decrease from specified thickness: 0.5 in.

2. Footings:

a. Footings other than those to receive masonry construction: Variation of bearing surface from specified elevation: Plus or minus 0.5 in.
b. Footings to Receive Masonry Construction:
1) Variation of center from specified location in plan: Plus or minus 0.25 in. in any 10 ft but not to exceed plus or minus 0.5 in.
2) Variation of bearing surfaces for specified elevation: Plus or minus 0.25 in. in any 10 ft but not to exceed plus or minus 0.5 in.

3. Piers, Columns, Walls, Beams, and Slabs:

a. Variation in cross-sectional dimensions of piers, beams and columns and in thickness of walls and slabs: 12 in. or less: Plus 0.375 in., minus 0.25 in. Greater than 12 in.: Plus 0.5 in., minus 0.375 in.
b. Variation in elevation from specified elevation for piers, columns and walls: Plus or minus 0.5 in.

4. Anchor bolts: concrete contractor shall place anchor bolts within tolerances stated under heading “Anchor Bolts and Bearing Plates” of PCI “Code of Standard Practice for Precast Concrete.”

C. Void Forms:

1. Protect all forms from moisture prior to concrete placement.
2. Install all forms and accessories in accordance with manufacturer's recommendations.
3. Protect all forms from puncture and moisture during concrete placement including accessories such as taped joints, seam pads and end caps.

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. Kerf wood inserts for easy removal.
3. 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.

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 bolts, accurately located, to elevations required.
2. Install reglets to receive top edge of foundation sheet 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 as indicated.

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 for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:

1. At least 70 percent of 28-day design compressive strength.
2. For post-tensioned concrete, formwork shall remain in place until post-tensioning has been completed. Do not place additional loads on structure until concrete has been properly reshored.
3. Specified compressive strength of 5000 psi. Determine compressive strength of in-place concrete by testing representative field cured test specimens according to ACI 301.
4. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. 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.

D. 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 SHORES AND RESHORES

A. Comply with ACI 347.2, ACI 318 and ACI 301, for design, installation, and removal of shoring and reshoring and in accordance with Article 1.5 “Contractor’s Professional Services – Performance and Design Criteria”.

1. Do not remove shoring until measurement of slab tolerances is completed.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR BARRIER

A. Vapor Barrier: Place, protect, and repair vapor-barrier or vapor sheets according to ASTM E 1643 and manufacturer’s written instructions.

3.6 STEEL REINFORCEMENT

A. General: Comply with CRSI’s “Manual of Standard Practice” for placing reinforcement.

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

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

1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.

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

E. Install welded wire reinforcement in longest practicable lengths on continuous bar supports spaced at 2 ft o.c., maximum. Lap edges and ends of adjoining sheets per ACI 318 and as follows:

1. Length of overlap measured between outermost cross wires of each sheet shall not be less than one spacing of cross wires plus two inches nor less than one and one-half times the development length nor 6 in. minimum where development length is calculated per section 12.8 of ACI 318.
2. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

F. Splices:

1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.
2. For mechanical tension splices of reinforcement:
    a. Column bar lengths shall not exceed 30 ft between splices. In any bar, no splices shall occur at any floor level.
    b. Exercise care to assure that no reduction of cross-sectional area of reinforcement occurs.
    c. For all mechanical splices, perform splicing in strict accordance with manufacturer’s requirements and instructions.
    d. Stagger splices in adjacent bars.
    e. Except where shown on Drawings, welding of reinforcement prohibited without prior written authorization by Engineer.
3. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.
4. Welded wire reinforcement shall not extend through contraction joints.

3.7 JOINTS

A. Joints in Concrete (ACI 301, Section 5):

1. Construction, control and isolation joints are located and detailed on Drawings:
    a. Tool joints at time of finishing. Tool: Part 2 Article “Tools.”
    b. Saw Cut Joints:
        1) Cut joint as soon as concrete will support weight of operator and saw without deforming.
        2) Joint shall be 1 in. deep for concrete thickness of 4 in. or less. Joint shall be 1.5 in. deep for concrete exceeding 4 in. thickness. Do not cut reinforcement.
        3) Extend joint to adjacent vertical surface within 30 minutes of cutting.

4) Retool or grind saw cut joint before installing sealant to provide equivalent dimensions, shape, and volume as joint obtained by tooled joint. Surface width shall be 0.5 in. with 3/16 in. to 1/4 in. edge radius.
5) All joints subject to acceptance by sealant installer. Rework rejected joints until acceptable to sealant installer.

c. Isolation joints: Interrupt structural continuity resulting from bond, reinforcement or keyway.
d. Construction and control joints in walls: Space joints at 20 ft. on center unless smaller spacing is shown on Drawings.
e. Construction or control joints in floor slabs on ground: Maximum slab area controlled by jointing 400 sq ft. Space joints at 20 ft. on center maximum unless different spacing is shown on Drawings.
f. Coordinate configuration of tooled joints with control joint sealants.

B. Provide keyways at least 1-1/2 in. deep in construction joints in walls and slabs. Accepted bulkheads designed for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Do not continue reinforcement through sides of strip placements.

D. Use bonding grout, containing the specified bonding admixture, on existing concrete surfaces that will be joined with fresh concrete.

E. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

1. Joint filler and sealant materials are specified in Division 7 Sections of these Specifications.

F. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown.

1. Tool contraction joints.
2. If joint pattern not shown, provide joints not exceeding 20 ft in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

G. Joint sealant material is specified in Division 7 Sections.

3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer’s written instructions.

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

3.9 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 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 mix.

C. Deposit concrete continuously or in 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 specified. Deposit concrete to avoid segregation.

D. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically (in thin slabs vibrator may be inserted at angle or horizontally to keep vibrator head completely immersed) inserted at uniformly spaced locations no farther than 1.5 times action radius so area visibly affected by vibrator overlaps adjacent previously vibrated area by 3-4 inches. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration (usually 5 to 15 seconds) of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge or motor driven vibrating screed and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using highway bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. 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 air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
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. Use only the specified non-corrosive accelerator. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mixture proportions.

G. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F 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. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

~~As-Cast Finishes: As-cast concrete texture imparted by form-facing material in accordance with ACI 301 and as specified below in accordance with Class of Finish:~~

~~Rough Form Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding limits for class of surface specified.~~

~~Provide class C finish as described in ACI 347, for surfaces permanently concealed from public view, unless otherwise noted in the Contract Documents. Class C permits gradual or abrupt irregularities of 1/2 inch.~~

~~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 defective areas. Remove fins and other projections exceeding limits for class of surface specified.~~

~~Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.~~

~~Provide class B finish as described in ACI 347. Class B permits gradual or abrupt irregularities of 1/4 inch.~~

~~Rubbed Finish: Apply the following to smooth-formed finished concrete to Architectural Exposed Concrete (AEC):~~

~~Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.~~

~~Locations: Where indicated on drawings.~~

A. Refer to Section 033300.

~~A. Refer to Section 033300.~~

3.11 FINISHING FLOORS AND SLABS

A. Flatwork in Parking and Drive Areas (BROOM Finish, ACI 301, Section 5 header "Broom or Belt Finish":

1. Bullfloat immediately after screeding. Complete before any excess moisture or bleed water is present on surface (ACI 302.1R, Article 8.3.3). The use of power trowels is discouraged; however, if they are used the following applies:

   a. Use minimal passes so as to not overwork the concrete.
   b. At the contractor's expense a petrographic analysis will be required in each area where a power trowel is used to verify the air content at the slab surface is within specified limits.
   c. After excess moisture or bleed water has disappeared and concrete has stiffened sufficiently to allow operation, give slab surfaces coarse transverse scored texture by drawing broom across surface. Texture shall be as accepted by Engineer from sample panels.

2. Finish tolerance: ACI 301, Paragraph 5.3.4.2 and ACI 117, paragraph 4.5.7: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5 in. In addition, floor surface shall not vary more than plus or minus 0.75 in. from elevation noted on Drawings anywhere on floor surface.
3. Before installation of flatwork and after submittal, review, and approval of concrete mixture proportions, Contractor shall fabricate two acceptable test panels simulating finishing techniques and final appearance to be expected and used on Project. Test panels shall be minimum of 20 ft. by 30 ft. in area and shall be reinforced and cast to thickness of typical parking and drive area wearing surface in Project. (Maximum thickness of test panels need not exceed 6 in.) Test panels shall be cast from concrete supplied by similar concrete batch, both immediately after addition of superplasticizer or water-reducing admixture, and at maximum allowed time for use of admixture-treated concrete in accordance with Specifications. Intent of test panels is to simulate both high and low workability mixes, with approximate slump at time of casting of test panels to be 6 in. and 3 in., respectively. Contractor shall finish panels following requirements of paragraphs above, and shall adjust finishing techniques to duplicate appearance of concrete surface of each panel. Finished panels (one or both) may be rejected by Engineer, in which case Contractor shall repeat procedure on rejected panel(s) until Engineer acceptance is obtained. Accepted test panels shall be cured in accordance with Specifications and may be incorporated into Project. Accepted test panels shall serve as basis for acceptance/rejection of final finished surfaces of all flatwork.
4. Finish all concrete slabs to proper elevations to ensure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear cost of any corrections to provide for positive drainage.

B. Flatwork in Stairtowers and enclosed, Finished Areas (Float Finish, ACI 301, Paragraph 5.3.4.2.b):

1. Give slab floated finish. Texture shall be as accepted by Engineer from sample panels.

2. Finishing tolerance ACI 301, Section 5 header “Measuring Tolerances for Slabs” and ACI 117, paragraph 4.5.7: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5 in. In addition, floor surface shall not vary more than plus or minus 3/8 in. from elevation noted on Drawings anywhere on floor surface.

C. Flatwork in Stair towers and Parking Garage floor subject to pedestrian traffic:

1. Refer to Section 033300.

3.12 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 Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still workable 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 of manufacturer furnishing machines and equipment.

3.13 CONCRETE PROTECTION AND CURING

A. General: Comply with ACI 308.1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Reducer: Apply evaporation reducer to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft./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. Do not finish immediately after evaporation reducer applied. Wait until after (green, if Confilm used – pink, if Eucobar used) film disappears.

C. Formed Surfaces: Cure formed concrete surfaces of columns, walls, and upturned beams. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing 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. Tepid (within 20 deg F of concrete temperature) water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch 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, 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.
3. Curing Compound: After Moisture or Moisture-Retaining-Cover Curing, 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. Apply two separate coats with first allowed to become tacky before applying second. Direction of second application shall be at right angles to direction of first.
    b. Curing compound prohibited when concrete has specified water-cementitious materials ratio less than or equal to 0.40 or air temperature above 80 deg F. Use moist cure instead.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, 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. Tepid (within 20 deg. F of concrete temperature) water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch 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, 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 recommends for use with floor coverings.
3. Curing Compound: Where permitted, apply uniformly in continuous operation by power spray or roller immediately after final finishing and the absence of surface moisture, 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. Apply two separate coats with first allowed to become tacky before applying second. Direction of second application shall be at right angles to direction of first.

b. Curing compound prohibited when concrete has specified water-cementitious ratio less than or equal to 0.40 or air temperature above 80 deg F. Use moist cure instead.

c. Removal: If curing compounds are used on surfaces (exterior or interior, formed or unformed) that are scheduled or specified to receive surface-adhered treatment (including but not limited to cementitious toppings/overlays, adhesive applied carpet, resilient flooring, terrazzo, thin-set ceramic tile/stone, wood, coatings, paint, waterproofing, membranes, athletic flooring, epoxy overlay/adhesive, hardeners, sealers, water repellents, or other covering system adhered with water-based adhesive), then the following requirements apply:

1) Remove curing compound no later than 7 days after end of curing period by mechanical bead blast process acceptable to Architect.

2) Allow sufficient additional time after curing compound removal to achieve proper concrete moisture and/or water vapor limitation for successful application of subsequent surface treatment as specified in appropriate surface treatment specification Section.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer/Architect. Remove and replace concrete that cannot be repaired and patched to Engineer/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 sieve, using only enough water for handling and placing. Use this repair procedure only with Engineer/Architect approval.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than ½ inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with specified bonding agent. Fill and compact with specified patching mortar before specified bonding agent has dried. Fill form-tie voids with specified patching mortar or cone plugs secured in place with specified 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 on mockup, or if none, 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 Engineer/Architect.

4. Repair isolated random cracks that have little movement and single holes not over 1 in. in diameter in accordance with procedures and materials specified in Division 7 Section “Concrete Joint Sealants.” Receive Engineer’s written acceptance of methods and materials selected prior to application.

    a. Repair isolated random horizontal cracks less than 0.01 in. wide, using silane sealer product specified in Division 7 “Water Repellants”

    b. Repair isolated random horizontal cracks 0.01 in. to less than 0.03 in. wide, using crack sealer product specified in Division 7 “Water Repellants.”

    c. Repair isolated random horizontal cracks 0.03 in. to 0.06 in. wide: route and seal with specified sealant product in Division 7 “Concrete Joint Sealants.”

    d. Repair isolated random vertical cracks more than 0.01 in. wide, using epoxy injection product specified in part 2 heading “Related Materials” of this section.

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.

1. Repair finished surfaces containing defects. Surface defects include spalls, pop-outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
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.
4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of ¼ inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer’s written instructions to produce a smooth, uniform, plane, and level surface.
5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete or latex modified concrete as approved by the Engineer. Remove defective areas with clean, square cuts and expose steel reinforcement with at least ¾ inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
6. Repair single holes 1 inch or less in diameter with patching mortar. Cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
7. Repair isolated random cracks that have little movement and single holes not over 1 in. in diameter in accordance with procedures and materials specified in

Division 7 Section “Concrete Joint Sealants.” Receive Engineer’s written acceptance of methods and materials selected prior to application.

a. Repair isolated random horizontal cracks less than 0.01 in. wide, using silane sealer product specified in Division 7 “Water Repellants”

b. Repair isolated random horizontal cracks 0.01 in. to less than 0.03 in. wide, using crack sealer product specified in Division 7 “Water Repellants.”

c. Repair isolated random horizontal cracks 0.03 in. to 0.06 in. wide: route and seal with specified sealant product in Division 7 “Concrete Joint Sealants.”

d. Repair isolated random vertical cracks more than 0.01 in. wide, using epoxy injection product specified in part 2 heading “Related Materials” of this section.

E. Perform structural repairs of concrete, subject to Engineer/Architect’s approval, using epoxy adhesive and patching mortar, latex modified concrete or other materials as approved by the Engineer.

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

3.15 FIELD QUALITY CONTROL

A. CM At Risk will employ a testing laboratory to perform tests and to submit test reports.

B. Sample concrete in accordance with ASTM C 172.

C. Temperature:

1. Test temperature of concrete in accordance with ASTM C 1064/C 1064M and ACI 301 each time cylinders are taken or as directed by the Engineer.

D. Slump Test:

1. Conduct one slump test in accordance with ASTM C 143/C 143M per truck load of ready-mixed concrete delivered to Project at truck for superstructure concrete.
2. Conduct slump test in accordance with ASTM C143/C 143M and ACI 301 for foundation concrete.
3. When high-range water-reducing admixture (superplasticizer) is used, initial slump must be verified by Testing Agency.

E. Slump Flow Test (SCC):

1. Conduct one slump flow test in accordance with ASTM C 1611/C 1611M per truck load of ready mixed concrete delivered to Project at truck for superstructure concrete.
2. Conduct slump flow test in accordance with ASTM C1611/C 1611M and ACI 301 for foundation concrete.

F. Water Content:

1. Water content and water-cementitious materials ratio shall be verified by use of the Microwave Test in accordance with AASHTO T 318.

2. Conduct test each time test cylinders are taken and as directed by Engineer.

G. Concrete Compressive Strength:

1. Mold test cylinders in accordance with ASTM C 31 and test in accordance with ASTM C 31 as follows:

   a. Take minimum of six cylinders (eight for post-tensioned cast-in-place concrete) for each 100 cu yd or fraction thereof, of each Mixture of concrete placed in any one day.

   b. Additional cylinders shall be taken under conditions of cold weather concreting per Part 3 Heading “Concrete Curing and Protection.”

   c. At Contractor’s option and cost, cylinders may be taken to verify concrete strength prior to form removal.

   d. Testing Agency: Provide and maintain site cure box for cylinders.

2. Sample plastic concrete for testing at point of final placement, in accordance with ASTM C 172. Engineer will select sampling locations which may include points where plastic concrete has already been screeded and floated. Sample concrete for test cylinders to be used to verify concrete compressive strength for post-tensioning as near as possible to actual tendon anchorages.
3. Cover specimens properly, immediately after finishing. Protect outside surfaces of cardboard molds, if used, from contact with sources of water for first 24 hours after molding.
4. Cure test cylinders per ASTM C 31 as follows:

   a. To verify compressive strength prior to post-tensioning or form removal or for additional test cylinders required due to cold weather concreting conditions:

      1) Store test specimens on structure as near to point of sampling as possible and protect from elements in same manner as that given to portion of structure as specimen represents.
      2) Transport to test laboratory no more than 4 hours before testing. Remove molds from specimens immediately before testing.

   b. To verify 28-day compressive strength:

      1) During first 24 hours after molding, store test specimens under conditions that maintain temperature immediately adjacent to specimens in range of 60 to 80 degrees F. and prevent loss of moisture from specimens.
      2) Remove test specimens from molds at end of 20 +/- 4 hours and store in moist condition at 73.4 +/- 3 degrees F. until moment of test. Laboratory moist rooms shall meet requirements of ASTM C 511.

5. Compression test for non-prestressed concrete:

   a. Test 2 cylinders at 7 days.

   b. Test 2 cylinders at 28 days.

   c. Test 2 cylinders at 56 days for concrete strength requirement of 7000 psi or greater, otherwise hold 2 cylinders in reserve for use as Engineer/Architect directs.

6. Compression tests for post-tensioned concrete:
    a. Test 2 cylinders immediately before tensioning slabs and 2 cylinders before tensioning beams. Cylinders must be field cured in accordance with paragraph “Cure test cylinders per ASTM C 31….”
    b. Test 2 cylinders at 28 days.
7. Hold 2 cylinders in reserve for use as Engineer directs.
8. Unless notified by Engineer, reserve cylinders may be discarded without being tested after 56 days.

H. Report all nonconforming test results to Engineer and others on distribution lists via fax or email. Follow up with colored paper copies to flag the non-conformances.

I. Monthly, submit a graph showing distribution of compressive strength test results and air content test results. Include microwave test results for concretes with a water cementitious ratio less than or equal to 0.40 concrete.

EVALUATION AND ACCEPTANCE OF CONCRETE

J. Concrete Compression test will be evaluated by Engineer in accordance with ACI 301. If number of tests conducted is inadequate for evaluation of concrete or test results for any type of concrete fail to meet specified strength requirements, core tests may be required as directed by Engineer. Air content and parameters of air-void system shall meet requirements of this Section.

K. Core tests, when required, in accordance with ASTM C42 and ACI 301.

L. Should tested hardened concrete meet Specifications, Owner will pay for coring and testing of hardened concrete. Should tested hardened concrete not meet Specifications or should concrete have to be tested because Contractor did not conform to Project specifications, Contractor shall pay for coring and testing of hardened concrete and for any corrective action required for unaccepted concrete.

3.16 ACCEPTANCE OF STRUCTURE

A. Acceptance of completed concrete Work will be according to provisions of ACI 301.

B. “RAPIDLOAD” testing is acceptable, by Structural Preservation Systems, Baltimore, MD.

END OF SECTION

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

I. GENERAL INFORMATION:	
Project:	City:
General Contractor:	
Concrete Supplier:	
Mixture Identification No.:	Concrete Grade:
Use (Describe)[1]:	

[1] example: Footings, interior flatwork, floor slabs, topping, columns, etc.

II. MIXTURE PROPORTIONING DATA:		
Proportioning Based on (Check only one): Standard Deviation Analysis: _____(see section VIII) or Trial Mix Test Data: _____ (see Section IX)		
Mixture Characteristics: (see Mixtures in Drawings General Notes)	Density: pcf;	Air: % specified
	Slump ____ in. before superplasticizer	Slump ____ in. after superplasticizer Or for SCC: Spread ____ in.
	Strength: _____ psi (28 day);	

WALKER SUBMITTAL STAMP

CONTRACTOR SUBMITTAL STAMP

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

III. MATERIALS:		
Aggregates: (size; type; source; gradation report; specification)		
Coarse:		
Fine:		
Other Materials:	Type	Product-Manufacturer (Source)
Cement:		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processed Ultra Fine Fly Ash		
HRM		
Air Entraining Agent:		
Water Reducer		
High Range Water Reducer (HRWR / superplasticizer)		
Non-Corrosive Accelerator		
Retarder		
Fibers		
Other(s):		

IV. MIX PROPORTIONS (2)		
	WEIGHT (lbs.) (per yd^3)	ABSOLUTE VOL. (cu. ft.) (per yd^3)
Cement:		
Fine Aggregate: (3)		
Coarse Aggregate: (3)		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processes Ultra Fine Fly Ash		

HRM		
Water: (.4) (gals. & lbs)		
Entrained Air: (oz.)		
Fibers:		
(Other) _____:		

TOTALS:		

NOTES:

(2) Mix proportions indicated shall be based on data used in section VII or IX.

(3) Based on saturated surface dry weights of aggregates.

(4) Includes ALL WATER, including added water and free water contained on aggregates.

V. RATIOS			VI. SPECIFIC GRAVITIES
Water(1)	lb		Fine Aggregate:
=	=		
Cementitious Material(2)	lb		Coarse Aggregate:
Fine Agg.	lb		
=	=		
Total Agg.	lb		

NOTES:

(1)Includes ALL water, including added water and free water contained on aggregates.

(2)Cementitious materials include cement, fly ash, slag, silica fume, HRM, Processed Ultra Fine Fly Ash or other pozzolan.

VII. ADMIXTURES				
Air Entraining Agent (A.E.A.):	___ oz.	per yd^3	___ oz.	per 100# cement
Superplasticizer	___ oz.	per yd^3	___ oz.	per 100# cement
Water Reducer	___ oz.	per yd^3	___ oz.	per 100# cement
Non-corrosive Accelerator	___ oz.	per yd^3	___ oz.	per 100# cement
Retarder	___ oz.	per yd^3	___ oz.	per 100# cement
Other	___ oz.	per yd^3	___ oz.	per 100# cement
Lithium Nitrate	___ gal.	per yd^3		

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

VIII. STANDARD DEVIATION ANALYSIS:	Yes	N/A
(Complete this section only if Mixture was developed using standard deviation analysis of previous project test results. If other method was used, check "N/A".)		
Number of Tests Evaluated: (One test is average of two cylinder breaks) Attach copy of test data considered:	Standard Deviation: (Single Group) Standard Deviation: (Two Groups)	
Required average compressive strength: f'cr = f'c + _____ psi		

NOTE:

Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'cr equal to or greater than the larger of one of the following equations:

(4.-3) f'cr = f'c + 1.34ks [s= calculated standard deviation]

or

(4-4) f'cr = f'c + 2.33ks – 500

or

(4-5) f'cr = 0.9f'c + 2.33ks (for f'c> 5,000 psi)

(Refer to ACI 301 for required average when data are not available to establish standard deviation. For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.)

MIXTURE CHARACTERISTICS (As shown on drawings)	
Slump = _____ in.	Air Content = _____ %
Unit Wet Wt. = _____ pcf	Unit Dry Wt. = _____ pcf

MIXTURE CHARACTERISTICS (Based on proportioning data)	
Initial Slump = _____ in.	Final Slump _____ in.
Unit Wet Wt.= _____ pcf.	Unit Dry Wt. = _____ pcf.
Air Content = _____ %	

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

IX. TRIAL MIXTURE TEST DATA:	Yes	N/A
(Complete this section only if Mixture Proportion is based on data from trial test mixture(s) batched by testing agency or Contractor. If other method was used, check "N/A".)		

Age (days)	Mix #1 (comp. str.)	Mix #2 (comp. str.)	Mix #3 (comp. str.)
7			
7			
28			
28			
28			
28 day average compressive strength, psi			

NOTE:

Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'cr equal to or greater than the larger of one of the following equations:

(Less than 3000) f'cr = f'c + 1000

or

(3000 to 5000) f'cr = f'c + 1200

or

(Over 5000) f'cr = 1.1f'c + 700

For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.

MIXTURE CHARACTERISTICS (as shown on drawings)	
Slump = _____ in.	Air Content = _____ %
Unit Wet Wt. = _____ pcf	Unit Dry Wt. = _____ pcf

MIXTURE CHARACTERISTICS (Based on proportioning data)	
Initial Slump = _____ in.	Final Slump _____ in.
Unit Wet Wt.= _____ pcf.	Unit Dry Wt. = _____ pcf.
Air Content = _____ %	

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

X. OTHER REQUIRED TESTS		
Water Soluble Chloride Ion Content of mix:	_____ %(by weight of cement)	ASTM C 1218
Hardened Air Content (per ASTM C457):		
Air content: _____%	Air void spacing Factor ____in.	Specific surface: ____in^2/in^3
Chloride Ion Content of Concrete Mixture: ASTM C 1218		
Shrinkage (Length Change, Average) per ASTM C157:		
_____% @ 4 days	_____% @ 7 days	_____% @ 14 days
_____% @21 days	_____% @28 days	

XI. Remarks:

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

Ready Mix Concrete Supplier Information
Name:
Address:
Phone Number:
Date:
Main Plant Location:
Miles from Project Site:
Secondary or Backup Plant Location:
Miles from Project Site:

My signature below certifies that I have read, understood, and will comply with the requirements of this Section.

Signature_____

Typed or Printed Name

REQUIRED ATTACHMENTS	
	Coarse aggregate grading report
	Fine aggregate grading report
	Concrete compressive strength data used for calculation of required average strength and for calculation of standard deviation
	Chloride ion data and related calculations
	Admixture compatibility certification letter
	Shrinkage information per ASTM C157
	ASTM C 457
	Alkali Content Data and Calculations OR ASTM C1293, ASTM C1260, ASTM C 1567 or CE CRD-C662 Test report for each aggregate

SECTION 03 3001 - CAST-IN-PLACE CONCRETE - PARKING GARAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture proportions, placement procedures, finishes, architectural finishes, and other miscellaneous items related to cast-in-place concrete.

B. Cast-in-place concrete includes project requirements specified herein and on drawings:
   1. Water/cementitious materials ratio: See General Notes on Drawings.
   2. Water Reducing Admixture: See Part 2 Article “Admixtures.”
   3. High strength: See General Notes on Drawings.

C. Work in other Sections related to Cast-in-Place Concrete:
   1. Division 1 Section “Project Management and Coordination.”
   2. Division 1 Section “Quality Control.”
   3. Division 3 Section “Post-Tensioned Concrete (Parking Garage.”
   4. Division 7 Section “Traffic Coatings (Parking Garage).”
   5. Division 7 Section “Water Repellants (Parking Garage).”
   6. Division 7 Section “Expansion Control (Parking Garage).”
   7. Division 7 Section “~~Concrete~~ Joint Sealants (Parking Garage).”
   8. Division 9 Section “Painting ~~(Parking Garage)~~.”

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans and ground granulated blast-furnace slag.

B. Self-Consolidating Concrete (SCC): Highly flowable, non-segregating concrete that can spread into place, fill the formwork, and encapsulate the reinforcement without any mechanical consolidation.

1.4 ACTION SUBMITTALS

A. Sustainable Design Documentation Submittals: Refer to section 01 8113.14 “Sustainable Design Requirements – LEED V4 BD+C”.
   1. Product Data: Documentation for Leadership Extraction Practices in the following:
      a. Regional/Local Multiplier Compliance
      b. Leadership Extraction Practices for Recycled Content
   2. Product Certificates: Provide the following:
      a. Environmental Product Declarations (EPD’s)

b. Corporate Sustainability Reporting (CSR's)

B. Submit Product data for concrete component materials and other concrete related items, including, but not limited to:
   1. Material Certificates: Signed by Manufacturer that each of the following items complies with requirements:
      a. Cementitious materials and aggregates
      b. Admixtures
      c. Form materials and form-release agents
      d. Steel reinforcement and accessories
      e. Fiber reinforcement
      f. Waterstops
      g. Curing materials
      h. Floor and slab treatments
      i. Bonding agents
      j. Vapor barriers/reducer
      k. Repair materials
   2. Submit certification that curing compound or evaporation reducer, if used, is compatible with sealer specified in Division 7 Section "Water Repellants", traffic topping specified in Division 7 section "Traffic Coatings", sealant specified in Division 7 Sections "~~Concrete~~ Joint Sealants – Parking Garage" and "~~Architectural~~ Joint Sealants", and expansion joint assemblies specified in Division 7 Section "Expansion ~~Joint Assemblies~~Control – Parking Garage."
   3. Submit certification that curing compound or evaporation reducer is compatible with pavement markings specified in Division 9.

C. Submit materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with or exceeds specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

D. Submit evidence of licensure in Florida for professional engineer providing professional services as required for Contractor in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures.
   1. Contractor's responsibilities include formwork, shoring and re-shoring procedures, and other work described in Article "Contractors Professional Design Services", Article "Formwork", and Article "Shores and Re-shores".
   2. Performance and design criteria are shown on the Drawings and in Article "Contractor's Professional Services- Performance and Design Criteria".
   3. Contractor's Professional Engineer shall furnish Owner a Certificate of Professional Liability Insurance in the amounts required per Division 1 of the specifications.
   4. Submit calculations and dimensions for "Nominal Form Width" for linear gap at time of forming or erecting concrete elements bounding the expansion joints in accordance with Drawings and Specification "Expansion Joint Assemblies".

E. Submit concrete mixture proportions to Engineer for each concrete mixture. Submit alternate mixture proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Provide mixture proportions not less than four weeks before placing concrete and not less than one week before pre-installation conference (pre-concrete meeting).
2. Proportion mixtures as defined in ACI 301 Section 4 header "Proportioning," Mixtures shall be proportioned by party other than Testing Agency responsible for testing Project concrete.
3. Proportion mixtures to minimize effects of thermal and drying shrinkage. See Part 2 heading "Concrete Mixtures" header "Shrinkage" for drying shrinkage limit.
4. Use mixture proportions submission form at end of this Section for each concrete mixture, which identifies the following:
   a. Mixture Proportions Identification and use.
   b. Method used for documentation of required average compressive strength, (ACI 301 Section 4 – *Field test data* or *Trial mixtures*).
   c. Gradation of fine and coarse aggregates.
   d. Proportions of all ingredients including all admixtures added either at time of batching or at job site.
   e. Water/cementitious materials ratio.
   f. Slump, ASTM C143.
   g. Certification of the chloride content of admixtures.
   h. Strength at 4 and 28 days, per ASTM C39. In addition, for post-tensioned concrete provide a strength gain curve with sufficient number of data points from 6 to 96 hours to accurately estimate when the minimum compressive strength for tensioning the concrete will be achieved. See Section "Post Tensioned Concrete – Parking Garage~~Unbonded Post-Tensioned Concrete~~."
   i. Water soluble chloride ion content of concrete: ASTM C 1218.
   j. Rapid Chloride Permeability test results per ASTM C 1202.
   k. Shrinkage (length change), ASTM C157 (modified) for cast-in-place post-tensioned concrete only. See Part 2 heading "Concrete Mixtures" header "Shrinkage" for modifications to ASTM C157.
   l. Certificate of analysis of coal fly ash or processed ultra fine fly ash: Comply with ASTM C618, Class C or F:

F. Testing Agency: Promptly report all field concrete test results to Engineer, Contractor and Concrete Supplier. Include following information:
   1. See Article "Quality Assurance."
   2. Density (unit weight) of concrete, ASTM C 138.
   3. Slump, ASTM C 143.
   4. Slump Flow, ASTM C 1611 (for SCC).
   5. Concrete temperature at placement time. ASTM C 1064.
   6. Air temperature at placement time.
   7. Strength determined in accordance with ASTM C 39.
   8. Rapid Chloride Permeability Test of core samples in accordance with ASTM C 1202, as and when directed by Specification or Owner.
   9. Shrinkage (length change) of superstructure concrete, ASTM C 157 (modified) for post-tensioned concrete and other concrete as noted on the drawings. Shrinkage shall be equal to or less than 0.04% at 28 days
   10. Calcium Nitrite presence in plastic concrete: See Part 3 heading, "Quality Control."

G. Contractor: Submit grout temperature limitations with grout submittal.

H. Submit current certification of welders.

I. Provide certification that curing compound conforms to requirements of ASTM C 1315.

J. All concrete flatwork finishers on Project shall hold current ACI Concrete Flatwork Finisher certification. Submit certification for each concrete flatwork finisher at Concrete Pre-Installation Conference and obtain Engineer's written acceptance.

K. Submit steel producer's certificates of mill analysis, tensile tests, and bend tests for reinforcing steel. Coordinate with welders and welding procedures.

L. Submit shop drawings for steel reinforcement:
1. Prepare placing drawings that detail fabrication, bending, and placement of concrete reinforcement. 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. Comply with ACI SP-66, "ACI Detailing Manual." Include special reinforcement required for openings through concrete structures, elevations of all walls and columns with locations of all splices and couplers.
2. Prepare steel reinforcement placing drawings in coordination with the Work of Section "Post Tensioned Concrete – Parking Garage~~Unbonded Post-Tensioned Concrete~~". Review the Unbonded Post-Tensioned Concrete tendon shop drawings to determine placement details and clearances. Notify Engineer of potential interference or conflicts for placing reinforcement and post-tensioning tendons.

M. Resubmittals: Engineer will review each of Contractor's submittals the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Construction Manager and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions.
1. Make resubmittals in same form and number of copies as initial submittal.
   a. Note date and content of previous submittal.
   b. Note date and content of revision in label or title block and clearly indicate extent of revision.

N. Resubmit submittals until they are marked with approval notation from Engineer's and Construction Manager's action stamp

O. Submit shop drawings for architectural finishes for specific exposed finish concrete surfaces. Show form construction including jointing, special form joint or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.

P. Submit samples of materials as requested by Engineer, including names, sources, and descriptions as follows:

1. Normal weight aggregates.
2. Fibrous reinforcement.
3. Reglets.
4. Waterstops.
5. Vapor retarder.

Q. Submit laboratory test reports for concrete materials and mixtures.

R. Submit Minutes of concrete pre-installation conference.

1.5 CONTRACTOR'S PROFESSIONAL SERVICES - PERFORMANCE AND DESIGN CRITERIA

A. Provide professional services for temporary conditions during construction and portions of the Work required to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Specific requirements and criteria include, but are not limited to the following:
   1. Design, erect, shore, brace, and maintain formwork, according to ACI 301 and ACI 347 to support vertical, lateral, static and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads. The contractor is responsible for layout and design, reviews, approvals, and inspections.
   2. Design formwork, shoring, bracing, and other conditions for structural requirements and stability during construction and until final structure is completed and accepted.
      a. Comply with ACI 347.2 for design, installation, and removal of shoring and reshoring.
      b. Superimposed loads to the concrete structure, slab-on-grade, and soil shall be less than the design loads as shown on Drawings.
      c. Check early-age strength of concrete members against anticipated construction loads. Reduce the load on concrete members at the critical concrete age or change the concrete mixture for accelerated strength gain to avoid distress of concrete members.
      d. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads such that no floor or member would be excessively loaded or would induce tensile stresses in concrete members.
      e. Plan sequence of removal of shores and reshores to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excess stress or deflection.
      f. Consider the effects of post-tensioning sequence for post-tensioned beams and girders. Review post-tensioning design criteria on the drawings and in specification Section "Post Tensioned Concrete – Parking Garage~~Unbonded Post-tensioned Concrete~~".

B. Design the "Nominal Form Width" for linear gap at time of forming or erecting concrete elements bounding the expansion joints in accordance with Drawings and Specification Section "Expansion Control – Parking Garage~~Joint Assemblies~~".

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Manufacturer Qualification: An experienced supplier who is experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirement for production facilities and equipment. Manufacturer shall also be certified according to the National Ready Mixed Concrete Association's Certifications of Ready Mixed Concrete Production Facilities.

C. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:
   1. ACI 301, "Specifications for Structural Concrete."
   2. ACI 318, "Building Code Requirements for Structural Concrete and Commentary."
   3. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials."
   4. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
   5. Florida Building Commission: FBC, "Florida Building Code."

D. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in Florida and who is experienced in providing professional engineering services of the kind indicated. See Article "Contractor's Professional Services Performance and Design Criteria".

E. Materials and installed work may require retesting at any time during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

F. PRE-INSTALLATION CONFERENCE: At least 21 days prior to scheduled start of concrete construction, contractor shall conduct meeting to review proposed mixture proportions and methods and procedures to achieve required concrete quality. Contractor shall send pre-concrete conference agenda to all attendees 14 days prior to scheduled date of conference indicating review requirements. Representatives of each entity directly concerned with cast-in-place concrete shall attend conference, including, but not limited to, the following:
   1. Contractor's superintendent.
   2. Agency (laboratory) responsible for concrete mixture proportions).
   3. Agency (laboratory) responsible for field quality control.
   4. Ready-mixed concrete producer.
   5. Concrete subcontractor.
   6. Primary admixture manufacturers.
   7. Engineer.
   8. Owner's representative.
   9. At the pre-concrete meeting the contractor shall provide a summary of concrete procedures to protect fresh concrete from rain.

   The minutes shall include a statement by the Concrete Contractor indicating that the proposed mixture proportions and placing/finishing/curing techniques can produce the concrete quality required by these specifications.

G. Welders and welding procedures for permanent steel formwork shall conform to requirements or AWS D1.1.

H. Welders and welding procedures shall conform to requirements of AWS D1.4. Except where shown on Drawings, welding of reinforcing steel is prohibited unless accepted by Engineer in writing.

I. Threshold Inspection of steel reinforcement is required in accordance with Florida Building Code, Section 105. Inspections shall be conducted by an inspection agency employed by Owner and approved by Engineer. Inspector shall provide report in approved format to Owner with copy to Engineer and Contractor. Inspection agency has authority to reject reinforcing not meeting Contract Documents. Inspections for all reinforcing steel for conformance to shop drawings and Contract Documents shall be completed prior to concrete placement.

J. Threshold Inspector shall submit following information on Inspection of Reinforcement unless modified in writing by Engineer.
   1. Project name and location.
   2. Contractor's name.
   3. Inspection Agency's name, address, and phone number.
   4. Date and time of inspection.
   5. Inspection Agency technician's name.
   6. Fabricator's name.
   7. Weather data:
      a. Air Temperatures.
      b. Weather.
      c. Wind speed.
   8. Inspection location within structure.
   9. Reinforcement inspection data (including but not limited to):
      a. Bar size, spacing, cover, and grade.
      b. Splices, bends, anchorages, welding.
      c. Support methods and construction sequencing.
   10. Inspection of other items related the concrete pour such as embed anchor bolts and connection plates, sleeves and openings or other items related to the structure. Refer to the Threshold Inspection Notes on the drawings.
   11. Diary of general progress of Work.

K. Owner's or Contractors Testing Agency Qualifications:
   1. Independent agency, acceptable to engineer, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   2. Testing laboratory shall submit documented proof of ability to perform required tests.
   3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 4, according to ACI CP-1 or an equivalent certification program.

L. Owner's or Contractors Testing Agency is responsible for conducting, monitoring and reporting results of all tests required under this Section. Testing Agency shall immediately report test results showing properties that do not conform to Project Specification requirements to General Contractor's authorized on-site representative and to Owner's authorized on-site representative.

M. Both Owner's and Contractors Testing Agency shall submit following Field Test information for Project Concrete unless modified in writing by Engineer:

1. Project name and location.
2. Contractor's name.
3. Testing Agency's name, address, and phone number.
4. Concrete supplier.
5. Date of report.
6. Testing Agency technician's name (sampling and testing).
7. Placement location within structure.
8. Time of batching.
9. Time of testing.
10. Elapsed time from batching at plant to discharge from truck at site.
11. Concrete mixture data (quantity and type):
    a. Cement.
    b. Fine aggregates.
    c. Coarse aggregates.
    d. Water.
    e. Water-reducing admixture and high-range water-reducing admixture.
    f. Other admixtures, including supplementary cementitious materials.
12. Weather data:
    a. Air temperatures.
    b. Weather.
    c. Wind speed.
13. Field test data:
    a. Date, time and place of test.
    b. Slump.
    c. Concrete Temperature.
    d. Slump flow (for SCC).
    e. Water content.
    f. Density (Unit weight).
14. Compressive test data:
    a. Cylinder number.
    b. Age of concrete when tested.
    c. Date and time of cylinder test.
    d. Curing time (field and lab).
    e. Cross-sectional area of cylinder.
    f. Compressive strength.
    g. Type of failure (at break).
    h. Rapid chloride permeability test results.

N. Mockups: Before casting concrete, build mockups to verify selections made under sample submittals and to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
1. Build two acceptable test panels approximately 600 sq. ft. for flatwork in parking drive areas slab-on-grade in the location indicated or, if not indicated, submit a request for acceptance of the proposed location at the project site. See additional requirements for test panels in specification article "Finishing Floors and Slabs."
2. Build panel approximately 100 sq. ft. for Smooth Form Finish - formed surface in the location indicated or, if not indicated, submit a request for acceptance of the proposed location at the project site.

a. Submit a request for acceptance of the proposed location for concrete ceilings.
b. Submit a request for acceptance of the proposed location for typical interior walls.

3. Build mockups of typical exterior wall of cast-in-place concrete as shown on Drawings.
4. Stains, bugholes or other surface blemishes that deviate from the mockup will not be acceptable.
5. Demonstrate curing, cleaning, and protecting of cast-in-place architectural concrete, finishes, and contraction joints, as applicable.
6. In presence of Engineer, damage part of the exposed-face surface for each finish, color, and texture, and demonstrate materials and techniques proposed for repair of tie holes and surface blemishes to match adjacent undamaged surfaces.
7. Obtain Engineer's acceptance of mockups before casting concrete with specified finishes.

O. Coal fly ash and processed ultrafine fly ash supplier shall make available qualified individual, experienced in placement of fly ash concrete, to aid Contractor. Qualification of supplier’s representative shall be acceptable to Owner. Representative shall attend pre-construction meeting, and shall be present for all trial placements, initial startup and then as required by Owner.

P. At all times during high-evaporation conditions, maintain adequate supply of evaporation reducer at site. Do not use evaporation reducer as finishing aid. See Part 3.

Q. Testing Agency: Identify those trucks of concrete supplier’s which meet requirements of NRMCA Quality Control Manual. Permit only those trucks to deliver concrete to Project.

1.7 REFERENCES

The following publications listed below form a part of this Specification to the extent referenced.

A. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO, “Standard Specifications for Highway Bridges.”
2. AASHTO T 318, “Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.”

B. American Concrete Institute (ACI):
1. ACI 214R, “Evaluation of Strength Test Results of Concrete.”
2. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
3. ACI 305R, “Hot Weather Concreting.”
4. ACI 306.1, “Cold Weather Concreting.”
5. ACI 308R, “Guide to Curing Concrete.”
6. ACI 308.1, “Standard Specifications for Curing Concrete.”
7. ACI 347, “Guide to Formwork for Concrete.”
8. ACI 347.2 “Guide to Shoring/Reshoring of Concrete Multistory Buildings.”
9. ACI 362.1, “Guide for the Design of Durable Parking Structures.”
10. ACI SP15, “Field Reference Manual.”

C. American Iron and Steel Institute (AISI):
   1. AISI, “Specification for the Design of Cold-Formed Steel Structural Members.”

D. American Society for Testing and Materials (ASTM):
   1. ASTM A 36, “Standard Specification for Carbon Structural Steel.”
   2. ASTM A 185, “Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement.”
   3. ASTM A 497, “Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete Reinforcement.”
   4. ASTM A 615, “Standard Specification for Deformed and Plain Carbon -Steel Bars for Concrete Reinforcement.”
   5. ASTM A 706, “Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.”
   6. ASTM B 633, “Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.”
   7. ASTM C 31, “Standard Practice of Making and Curing Concrete Test Specimens in the Field.”
   8. ASTM C 33, “Standard Specification for Concrete Aggregates.”
   9. ASTM C 39, “Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.”
   10. ASTM C 94, “Standard Specification for Ready-Mixed Concrete.”
   11. ASTM C 109, “Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).”
   12. ASTM C 138, “Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.”
   13. ASTM C 143, “Standard Test Method for Slump of Hydraulic Cement Concrete.”
   14. ASTM C 150, “Standard Specification for Portland Cement.”
   15. ASTM C 157, “Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.”
   16. ASTM C 171, “Standard Specification for Sheet Materials for Curing Concrete.”
   17. ASTM C 172, “Standard Practice for Sampling Freshly Mixed Concrete.”
   18. ASTM C 173, “Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.”
   19. ASTM C 231, “Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.”
   20. ASTM C 260, “Standard Specification for Air-Entraining Admixtures for Concrete.”
   21. ASTM C 309, “Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.”
   22. ASTM C 311, “Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.”
   23. ASTM C 330, “Standard Specification for Lightweight Aggregates for Structural Concrete.”
   24. ASTM C 457, “Standard Test Method for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete.”
   25. ASTM C 494, “Standard Specifications for Chemical Admixtures for Concrete.”
   26. ASTM C 567, “Standard Test Method for Determining the Density of Structural Lightweight Concrete.”
   27. ASTM C 595, “Standard Specification for Blended Hydraulic Cements.”

28. ASTM C 618, “Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.”
29. ASTM C 666, “Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.”
30. ASTM C 672, “Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.”
31. ASTM C 989, “Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.”
32. ASTM C 1064/C 1064M “Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.”
33. ASTM C 1077, “Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.”
34. ASTM C 1116, “Standard Specification for Fiber-Reinforced Concrete and Shotcrete.”
35. ASTM C 1202, “Standard Test Method for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration.”
36. ASTM C 1218, “Standard Test Method for Water Soluble Chloride Ion in Mortar and Concrete.”
37. ASTM C 1240, “Standard Specification for Silica Fume Used in Cementitious Mixtures.”
38. ASTM C 1260, “Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar Bar Method).”
39. ASTM C 1293, “Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.”
40. ASTM C 1315, “Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.”
41. ASTM C 1567, “Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerate Mortar Bar Method).”
42. ASTM C 1602/C 1602M, “Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.”
43. ASTM C 1610/C 1610M, “Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique.”
44. ASTM C 1611/C 1611M, “Standard Test Method for Slump Flow of Self-Consolidating Concrete.”
45. ASTM C 1621/C 1621M, “Standard Test Method for Passing Ability of Self-Consolidating Concrete by J-Ring.”
46. ASTM D 448, “Standard Classification for Sizes of Aggregate for Road and Bridge Construction.”
47. ASTM E 96/E 96M, “Standard Test Methods for Water Vapor Transmission of Materials.”
48. ASTM E 1643, “Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.”
49. ASTM E 1745 “Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.”
50. ASTM F1637 02, “Standard Practice for Safe Walking Surfaces.”

E. American Welding Society (AWS):
   1. AWS D1.1, “Structural Welding Code-Steel.”
   2. AWS D1.4, “Structural Welding Code-Reinforcing Steel.”

F. US Army Corps of Engineers (CE):
1. CE CRD-C 513 “Specifications for Rubber Waterstops.”
2. CE CRD-C 572 “Specifications for Polyvinyl Chloride Waterstops.”
3. CE CRD-C 662 “Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar Bar Method.”

G. Contractor shall have following ACI publications at Project construction site:
1. ACI SP-15, “Field Reference Manual: Standard Specifications for Structural Concrete ACI 301 with selected ACI References.”
2. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
3. ACI 305R, “Hot Weather Concreting.”
4. ACI 306.1, “Cold Weather Concreting.”

H. Accessibility Requirements:
1. “Americans with Disabilities - Act Accessibility Guidelines for Buildings and Facilities”, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111, 1-800-872-2253, http://www.access-board.gov/adaag/ADAAG.pdf

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store all formwork and formwork materials clear of ground, protected, to preclude damage.

B. Deliver reinforcement to Project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

C. Store concrete reinforcement materials at site to prevent damage and accumulation of dirt or excessive rust.

D. Concrete transported by truck mixer or agitator shall be completely discharged within one and one half-hours (one hour for hot weather concreting) after water has been added to cement or cement has been added to aggregates. Schedule deliveries to allow for delays due to weather, traffic, etc.

PART 2 - PRODUCTS

2.1 FORM 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. 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.

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 Textured Finish Concrete: Unit of face design, size, arrangement, and configuration to match control sample. Provide solid backing and form supports to ensure stability of textured form liners.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
1. Products include all corrugated cardboard void forms that temporarily support concrete walls, grade beams, structural concrete slabs and top portion of concrete piers; includes filling the circular section where required.
a. Related accessory products include seam caps, end caps and protective cover boards or any other product to maintain above general products.
b. Submit all product data and manufacturer’s installation instructions under provisions of this Section, based on the design loads specified in contract documents and depth and width indicated.

F. Form Coatings: Provide commercial formulation form-coating compounds with a maximum VOC of 350 grams/liter that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces, including but not limited to water-curing, curing compound, stains or paints.

G. Form Ties: Factory - fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1.5 in. to exposed surface.
1. Provide ties that, when removed, will leave holes not larger than 1 in. diameter in concrete surface.

H. Chamfer strips: Wood, metal, PVC, or rubber strips. 0.75 in. by 0.75 in. min. unless noted otherwise.

I. Nails for P-T Anchors: Stainless steel ring shank nails.
1. Clendenin Brothers, Baltimore, MD.
2. Or Equal.

2.2 STEEL REINFORCEMENT

A. Provide in Bid 20 additional tons of placed reinforcement bars or welded wire reinforcement for inclusion in Project as Engineer directs. Return cost of unused portion to Owner. Submit to Engineer breakdown of use each month.

B. Reinforcement Bars: ASTM A 615, deformed, yield strength: as noted on Drawings.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

D. Post-tensioned Reinforcement: See Section "Post Tensioned Concrete – Parking Garage~~Unbonded Post-Tensioned Concrete~~."

E. Steel Bar Mats: ASTM A 184, assembled with clips.
1. Steel Reinforcement: ASTM A 615, Grade 60, deformed bars.

F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
1. Welded wire reinforcement: provide in mats only. Roll stock prohibited.

G. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.

2.3 REINFORCEMENT ACCESSORIES

A. Bar supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from all plastic of greater compressive strength than concrete, and as follows:
1. In manner acceptable to Engineer solely, bar and welded wire reinforcement supports shall be color-coded to visually differentiate supports by height and shall be fabricated to resist overturning during construction operations.
2. For slabs on ground, use all-plastic supports with sand plates or horizontal runners where base materials will not support chair legs. All supports shall have sufficient surface area in contact with ground so that they shall not allow clearance loss when reinforcement installed or concrete placed.
3. For concrete surfaces exposed to view where bar supports contact forms, supports shall have minimal contact, shall not cause voids and shall not cause damage to surrounding concrete. Use all-plastic supports conforming to CRSI Class 1 protection requirements.
4. Chairs shall be sized and spaced to prevent cover loss during construction operations.
5. Acceptable manufacturers:
   a. Aztec Concrete Accessories, Inc.
   b. General Technologies, Inc.
   c. Accepted equivalent.
6. For welded wire reinforcement, provide continuous bar supports spaced at 2 feet o.c., maximum."

B. For mechanical tension splices of reinforcement:
1. All splices to develop 125 percent of specified yield strength of bars, or of smaller bar in transition splices. Acceptable products:
   a. Bar-Lock Rebar Coupler, by Dayton Superior.
   b. Bar-Grip or Grip-Twist, by Barsplice Products, Inc.
   c. Extender Coupler, by Headed Reinforcement.
   d. Splice Sleeve, by NMB.
   e. LENTON Splices, by Erico.

C. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.

2.4 CONCRETE MATERIALS

A. Ready Mixed Concrete: Obtain concrete from plant with current certification from:
1. Concrete Materials Engineering Council.
2. Florida Department of Transportation.
3. National Ready Mixed Concrete Association.

B. Portland Cement (ACI 301, Section 4 header “Cementitious Materials”):
1. Portland cement, Type I, ASTM C 150. Use one cement supplier throughout project. No change in brand or supplier without prior written acceptance from Engineer.
2. Blended cement, ASTM C 595, Type IP only with prior written acceptance from Engineer.

C. Coal Fly Ash:
1. Permitted in all parts of structure.
2. ASTM C 618, Class C or F.
3. Testing: ASTM C311.
4. Percentage of fly ash in Mixture Proportion shall be by weight, not by volume. Water/cement ratio will be calculated as water/cementitious (total cement and fly ash) ratio.
5. If project contains post-tensioned members, see Section “Post Tensioned Concrete – Parking Garage~~Unbonded Post-Tensioned Concrete~~,” for high early strength requirements for concrete to be post-tensioned.
6. Prohibited: Fly ash in same mix with Type IP blended cement.
7. If strength or air content varies from value specified by more than specified tolerances, Engineer or designated representative shall reject that concrete.
8. Submit all fly ash concrete Mixture Proportions per ACI 301.

D. Slag – (Ground Granulated Blast-Furnace Slag – GG-BFS):
1. ASTM C 989, Grade 100 or higher.
2. Percentage of GGBF slag in Mixture Proportion shall be by weight, not by volume. Water-cement ratio shall be calculated as water-cementitious (total portland cement + GGBF slag) ratio.
3. If strength or air content varies from value specified by more than specified tolerances, Engineer or designated representative shall reject that concrete.
4. Submit all GGBF slag concrete mixture proportions per ACI 301.

E. Normal Weight Aggregates (ACI 301, Section 4 header “Aggregates”):
1. Normal weight concrete aggregates:
   a. Coarse aggregate: Crushed and graded limestone or approved equivalent conforming to ASTM C33 except as noted here, minimum class designations as listed below:
      1) Below grade construction and below frost line: Class 1N.
      2) Walls not exposed to public view: Class 1N.
      3) Walls exposed to public view: Class 1N.
      4) Slabs on ground: Class 1N.
      5) All other concrete: Class 1N.

b. No deleterious materials such as, but not limited to, chert or opaline.
c. Fine aggregate: Natural or Manufactured sand conforming to ASTM C 33 and having preferred grading shown for normal weight aggregate in ACI 302.1R, Table 5.1.
d. Coarse Aggregate shall not contain crushed hydraulic-cement concrete.

2. Coarse aggregate: Nominal maximum sizes indicated below, conforming to ASTM C 33, Table 2:

a. Footings/Foundations: Size number 57 or 357.
b. Slab on grade: Size number 57.
c. All other members: Size number 67.

3. Chloride Ion Level: ASTM C 1218. Chloride ion content of cement, aggregates and all other ingredients: tested by laboratory making trial mixes.

F. Water: Comply with ASTM C 1602.

G. Storage of Materials (ACI 301, Section 4 header “Materials Storage and Handling”).

2.5 ADMIXTURES

A. Use water-reducing admixture, mid-range water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete as required for placement and workability.

B. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg. F as required for schedule.

C. Use high-range water-reducing admixture (HRWR) in pumped concrete, and for concrete with water/cementitious ratio of less than or equal to 0.45. Use high-range or mid-range water-reducing admixtures in pumped concrete and normal or mid-range water reducing admixtures for concrete with water/cementitious ratios greater than 0.45.

D. Self-consolidating concrete (SCC) may be used where placement due to either dense reinforcement or form design requires both a high level of workability (horizontal slump flow greater than 24 in. diameter) and the water/cementitious ratio is less than or equal to 0.45.

E. Only admixture manufacturers listed acceptable. Do not submit alternate manufacturers.

F. Concrete supplier and manufacturer shall verify via trial mixes and certify compatibility (no adverse effect on workability, strength, durability, entrained air content, etc.) of all ingredients in each Mixture. Use admixtures in strict accordance with manufacturer’s recommendations.

G. Prohibited Admixtures: Calcium chloride or admixtures containing intentionally added chlorides shall not be used.

H. Normal Water-Reducing Admixture: ASTM C 494, Type A.
1. Products: Subject to compliance with requirements, provide one of following:

a. “Eucon Series,” Euclid Chemical Co.
b. “WRDA Series,” GCP Applied Technoligies (Grace)
c. “Pozzolith Series,” or “PolyHeed Series,” BASF Construction Chemicals.
d. “Plastocrete Series”, Sika Corporation.

I. Mid Range Water-Reducing Admixture: ASTM C 494, Type A.
1. Subject to compliance with requirements, provide one of following:
a. “Eucon MR” or “Eucon X-15 and X-20,” Euclid Chemical Co.
b. “Daracem Series” or “MIRA Series,” GCP Applied Technoligies (Grace)
c. “PolyHeed Series,” BASF Construction Chemicals.
d. “”Sikaplast Series” or “Plastocrete Series”, Sika Corporation.
e. “Catexol 2000 NI,” Axim Concrete Technologies.
f. “Polychem 1000” or “KB Series,” General Resource Technology.
g. “Finishease-NC,” Russ Tech Admixtures, Inc.

J. High Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F.
1. Products: Subject to compliance with requirements, provide one of following:
a. “Eucon 37” or “Eucon SP-Series” or “Plastol Series,” Euclid Chemical Co.
b. “Daracem Series” or “ADVA Series,” GCP Applied Technoligies (Grace)
c. “Rheobuild 1000”, “PS 1466” or “Glenium Series,” BASF Construction Chemicals.
d. “Sikament Series” or “Sika ViscoCrete Series,” Sika Corporation.
e. “Catexol 1000 SP-MN,” Axim Concrete Technologies.
f. “Melchem Series,” General Resource Technology.
g. “Superflo 443” or “Superflo 2000 Series,” Russ Tech Admixtures, Inc.

K. High-Range Water-Reducing Admixture (Superplasticizer) for Self-Consolidating Concrete, ASTM C 494 Type F.

1. Products: Subject to compliance with requirements, provide one of the following:
a. “Plastol Series” or “Eucon SPC or SPJ,” Euclid Chemical Co.
b. “ADVA Series,” GCP Applied Technoligies (Grace)
c. “Glenium Series” or “PS1466,” BASF Construction Chemicals.
d. “Sika ViscoCrete Series” or “Sikament Series”, Sika Corporation.

L. Viscosity Modifying Admixture for Self-consolidating Concrete:
1. Products: Subject to compliance with requirements, provide one of the following:
a. “Visctrol” or “Eucon ABS,” Euclid Chemical Co.
b. “Rheomac VMA Series,” BASF Construction Chemicals.
c. “Sika Stabilizer Series,” Sika Corporation.

M. High Range water reducing retarding (superplasticizer), ASTM C 494 Type G:
1. Products: Subject to compliance with requirements, provide one of following:
a. “Eucon 537 or RD2,” Euclid Chemical Co.
b. “Daracem 100,” GCP Applied Technoligies (Grace)

N. Non-Chloride, Non-Corrosive Water-Reducing, Accelerating Admixture: ASTM C 494, Type C or E.
1. Products: Subject to compliance with requirements, provide one of following:

a. “Eucon AcN-Series,” “Accelguard 80,” “Accelguard NCA,” or “Accelguard 90,” Euclid Chemical Co.
b. “DCI,” “PolaraSet,” “Lubricon NCA,” or “Gilco,” GCP Applied Technoligies (Grace)
c. “Pozzutec 20+” or “Pozzolith NC 534,” BASF Construction Chemicals.
d. “Sika Set NC,” “Plastocrete 161FL”, or “Sika Rapid-1,” Sika Corporation.
e. “Catexol 2000 RHE,” Axim Concrete Technologies.

O. Water-Reducing or retarding Admixture: ASTM C 494, Type D or B.
1. Products: Subject to compliance with requirements, provide one of following:
a. “Eucon Retarder-75”, “Eucon DS” or “Eucon W.O.” Euclid Chemical Co.
b. “Daratard-17” or “Recover,” GCP Applied Technoligies (Grace)
c. “Pozzolith Series” or “Delvo Series,” BASF Construction Chemicals.
d. “Sikatard Series,” or “Plastiment Series” or “Plastocrete Series,” Sika Corporation.
2. Products:
a. “ASRx 30LN,” BASF Construction Chemicals.
b. “Eucon Integral ARC,” Euclid Chemical Co.
c. “Sika Control ASR”, Sika Corporation.
d. “Rasir,” GCP Applied Technoligies (Grace)
3. Include water content in admixture when calculating water-to-cement ratio.
4. Provide satisfactory CE CRD-C667 results with lithium admixture as defined in “Alkali-Aggregate Reactivity Resistance” paragraph below.

P. Shrinkage Reducing Admixture:
1. Design requires using materials with combined drying shrinkage characteristic of 0.04 percent maximum at 28 days. Proposed concrete Mixture(s), using actual aggregates, admixtures and cement of the proposed mix for Project as detailed herein and in Drawings, shall meet criteria. Submit ASTM C 157 (may be modified by curing period duration) results for at least 3 specimens. Test takes 28 days minimum. Begin tests as soon as possible so final test results available for submittal to Engineer.
2. Products: Subject to compliance with requirements, provide one of following:
a. If calcium nitrite is present in the original concrete mixture:
1) “Eclipse 4500,” GCP Applied Technoligies (Grace)
2) “Eucon SRA +” Euclid Chemical Company.
3) “Sika Control 40”, Sika Corporation.
b. If calcium nitrite is not present in the original concrete mixture:
1) “Eucon SRA,” or “Eucon SRA+,” Euclid Chemical Company.
2) “Eclipse Plus,” GCP Applied Technoligies (Grace)
3) “Tetraguard AS 20,” BASF Construction Chemicals.
4) “Sika Control 40,” Sika Corporation.
5) “SRA-157, “Russ Tech Admixtures, Inc.

2.6 FIBER REINFORCEMENT:

A. Polypropylene fibers for plastic shrinkage control in concrete members.
1. Products: Subject to compliance with requirements, provide one of the following:
a. “Fiberstrand 100,” Euclid Chemical Co.

b. "Mighty-Mono," Forta Corp.
c. "Polymesh," General Resource Technology.
d. "Gilco," or "Grace Fibers," or "Grace Microfibers," GCP Applied Technoligies (Grace), Inc.
e. "Durafiber," Industrial Systems, Ltd.
f. "MasterFiber F or M Series," BASF Construction Chemicals.
g. "Fibermesh 150," Propex Concrete Systems.
h. "Sika Fibers," or "Sika Microfibers," Sika Corporation.

2. Additional requirements:
   a. Collated fibrillated materials: Dosage rate 1.0 lb/cu. yd. of concrete minimum, containing at least 3 million individual fibers.
   b. Multifilament (microfilament) fibers: Dosage rate 0.5 lb/cu. yd. of concrete minimum, containing at least 25 million individual fibers. Minimum length 0.75 in.
   c. Meet requirements of ASTM C 1116, "Standard Specification for Fiber-Reinforced Concrete and Shotcrete," designation Type III,
   d. Meet minimum plastic shrinkage crack reduction of 70 percent when tested in accordance with ICBO ES, Appendix B (7-92).

B. Use shall not change water requirement of mix. Slump loss due to addition of fiber shall be offset by addition of superplasticizer.

C. Conform to manufacturer's recommendations for quantity of fiber. See paragraph "Additional Requirements" above for minimums.

D. See Drawings for locations of allowable use.

E. Fiber manufacturer or approved distributor: Provide services of qualified representative at pre-construction meeting, concrete pre-installation meeting and first concrete placement containing fibers.

2.7 WATERSTOPS

A. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: Flat, dumbbell without center bulb.

B. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Profile: Flat, dumbbell without center bulb.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Rubber Waterstops:
      a. Greenstreak.
      b. Progress Unlimited Inc.
      c. Williams Products, Inc.
   2. PVC Waterstops:
      a. Greenstreak.

b. Meadows: W.R. Meadows, Inc.
c. Progress Unlimited Inc.
d. Sternson Group.

D. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Superstop; Tremco Inc.
b. Volclay Waterstop-RX; Colloid Environmental Technologies Co.
c. Hydrotite; Greenstreak.
d. Mirastop; Miradri, Div. Of Royal Ten Cate (USA), Inc.
e. Superstop; Progress Unlimited Inc.
f. SikaSwell Profile; Sika Corporation.

2.8 VAPOR BARRIERS

A. Vapor Barrier: Provide vapor barrier which conforms to ASTM E 1745, Class A. The membrane shall have a water-vapor transmission rate less than or equal to 0.008 gr./ft^2/hr when tested, in accordance with ASTM E96. Vapor barrier shall be no less than 15 mils thick. The vapor barrier shall be placed over prepared base material where indicated below slabs on ground.
1. New ISO certified virgin resins, polyolefin based maximum.
2. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to “Griffolyn Vaporguard” by Reef Industries, Inc., Stego Wrap (15-Mil) Vapor Barrier by Stego Industries LLC, or Perminator (15 Mil) Underground Vapor Barrier by W.R. Meadows,.

B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM D 448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

2.9 CURING MATERIALS

A. Evaporation Reducer: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Evaporation Retarder:
a. Cimfilm; Axim Concrete Technologies.
b. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
c. Eucobar; Euclid Chemical Co.
d. E-Con; L&M Construction Chemicals, Inc.
e. Confilm; BASF Construction Chemicals, LLC.
f. SikaFilm; Sika Corporation.
g. Sure-Film (J-74); Dayton Superior Corporation.
h. “EVRT”, Russ Tech Admixtures, Inc.

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

C. Moisture-Retaining Cover: Polyethylene coated burlap comprised of a minimum 4 mil polyethylene extruded onto 10- ounce burlap with components complying with AASHTO M171, AASHTO M182 Class II and ASTM C-171. The cover shall be suitable for multiple uses. Acceptable products:
   1. Hydracure M5 by Hydracure Covers
   2. Bur Lene by Max Katz Bag Co. Inc
   3. Curelap-Poly Coated Burlap by Midwest Canvas Corp.
   4. UltraCure DOT by Sika Corporation..

C. Water: Potable.

D. Curing Compound (VOC Compliant, less than 350 g/l): Comply with ASTM C 309, Type 1, Class A or B. Moisture loss shall be not more than 0.55 kg/m^2 when applied at 200 sq. ft/gal. Manufacturer's certification is required. Silicate based compounds prohibited.
   1. Subject to project requirements provide one of the following products:
      a. "Kurez DR VOX" or "Kurez RC," or "Kurez RC Off," Euclid Chemical Company.
      b. "RxCure WB," or "RxCure VOC" or "W.B. Cure VOC," Conspec Marketing & Manufacturing.
      c. "Kure N Seal W" or "Kure N Seal WB" BASF Construction Chemicals, LLC.
   2. Additional requirements:
      a. With product submittal provide plan and procedures for removal of residual curing compound prior to application of sealers, coatings, stains, pavement markings and other finishes.
      b. Provide a summary of testing to show adequate surface preparation for successful application of sealers, coatings, stains, pavement markings, and other finishes.

2.10 RELATED MATERIALS

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

B. Epoxy-Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
   1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
   2. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

C. Reglets: Fabricate reglets of not less than 0.0217-inch- thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

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

E. Mechanical and chemical anchors as specified on the drawings or used for attaching supports for miscellaneous electrical, plumbing and mechanical components along with repairs for missing embeded anchor bolts shall be manufactured by Hilti Fastening Systems, Tulsa Oklahoma, ITW Ramset/Red Head, Wood Dale, IL, Simpson Anchor Systems, Columbus, OH, Powers Fasteners, Brewster, NY, SimpsonStrong-Tie Co., Inc., Pleasanton, CA, Powers Fasteners, Brewster, NY, or accepted equivalent. Anchor bolt composition shall be from one or more of carbon steel and stainless steel, lead, Zamac alloy, nylon, plastic, polypropylene, and jute fiber.
   1. Strength of all anchors shall comply with ICC-ES-AC 193 or ICC-ES AC308 and ACI 318-11 Appendix D.
   2. Carbon steel anchors shall be either zinc plated in accordance with ASTM B 633, or hot-dipped galvanized in accordance with ASTM A-153-78. Provide mill test reports and manufacturer's quality control certification upon Engineer's request.
   3. Stainless steel anchors shall be manufactured from ASTM A304, or A663 stainless steel. Provide mill test reports and manufacturer's quality control certification upon Engineer's request.
   4. Plastic, lead, or Zamac alloy anchors shall not be used for overhead applications Chemical anchors shall not be used to resist pullout forces in overhead and wall installations unless proper consideration is given to fire conditions. For chemical anchors, consult with manufacturer's engineer.
   5. Safety Factors: Static load safety factors shall be per manufacturer's published data. Critical load (vibratory, overhead, etc. or more) safety factors shall be 10:1 minimum. Chemical anchors are not permitted for critical loads and where resistance to direct sustained tension is required.
      a. If necessary for purposes of determining tensile and/or shear capacity in questionable base material, testing shall be done prior to actual anchor installation. Proof load, load duration and ASTM procedures will be provided for the testing procedure. A maximum of five tension and/or shear tests shall be performed by manufacturer's engineer. Anchors shall be proof loaded in tension and/or shear to assure that working load capacity is within specified allowable load limit as published by manufacturer.
   6. Anchor spacing and edge distance per manufacturer's limits. Loading and cluster spacing shall be as established by minimum industry standards for anchors, except as follows: Anchor loading, cluster spacing and edge distances shall be as published in manufacturer's literature. Consult with manufacturer's engineer for specific requirements.
   7. Anchor installation shall be as required by manufacturers written instructions.
   8. Refer to the general notes for additional information on "Post-Installed Anchors".

F. Inserts and Coil Rods:
   1. Yield strength: 65,000 psi minimum.
   2. Galvanizing: Where indicated, electrodeposited zinc coating, ASTM B 633, Service condition 1, Type III.
   3. Acceptable manufacturers:
      a. Dayton/Richmond Concrete Accessories, Inc., Miamisburg, OH.
   4. Details shown on drawings are based on Dayton/Richmond Concrete Accessories, Inc. products and their respective capacities. Other products may

be used only if contractor submits calculations, sealed by professional engineer or structural engineer licensed in Florida, substantiating strength of connection with other product. Calculations are subject to Engineer's acceptance before fabrication is to proceed.

G. Joint Filler:
1. Joint filler in slabs and curbs: Asphalt impregnated fiber board; as shown on Drawings. Acceptable products:
   a. "Flexcell," Knight-Celotex Corp.
   b. "Fibre Expansion Joint," W.R. Meadows, Inc.
2. Joint filler used vertically to isolate walls from columns or other walls: White molded polystyrene beadboard type.
3. Joint cover used to bridge gap between columns and grade walls, retaining walls, or basement walls: Minimum width: Gap width plus 4 in. For gaps over 3 in. wide, protect cover with protection board sized to span gap satisfactorily. Acceptable products:
   a. "Sealtight Melgard," W.R. Meadows, Inc., Elgin, Illinois and shall be applied according to manufacturer's instructions.
   b. Acceptable substitute.

H. Slide Bearing System at Expansion Joints:
1. Provide slide bearing system as shown and detailed on Drawings:
   a. Beam slide bearings shall be reinforced PTFE: 100 percent virgin tetrafluoroethylene polymer and ground glass fiber reinforcing aggregate, prebonded to stainless steel. Acceptable slide bearing systems:
   ~~a. Beam and double tee bearings shall be reinforced PTFE: 100 percent virgin tetrafluoroethylene polymer and ground glass fiber reinforcing aggregate, prebonded to stainless steel and/or preformed fabric (Section "Plant Precast Structural Concrete," Part 2 Article "Materials," paragraph "Bearing Pads") bearing pads. Acceptable slide bearing systems:~~
      1) "Fluorogold," Seismic Energy Products, L.P. Pine Brook, New Jersey.
      2) "Balco," Balco, Inc., Wichita, Kansas.
      3) "Alert 15175 Shock Pads with TFE," Alert Manufacturing and Supply Co. Chicago, Illinois.
      4) "Dura-Slide," Tobi Engineering, Inc., Elk Grove Village, Illinois.
      5) "Dynalon Slide Bearings with Masticord," JVI, Inc., Skokie Illinois.
   b. Slab slide bearings shall be ultrahigh molecular weight, high-density polyethylene resin: Acceptable material:
   ~~b. Slab and plank bearings shall be ultrahigh molecular weight, high-density polyethylene resin: Acceptable material:~~
      1) "Korolath PE," Korolath Corporation, Hudson, Mass.
      2) "Tivar-1000," Poly-Hi/Menasha Corporation, Fort Wayne, Indiana.
      3) "UHMW Econ-o-Shim," Deslausiers, Inc., Bellwood IL.
2. Backing materials for reinforced PTFE slide bearing systems as shown on Drawings:
   a. Galvanized steel.
   b. Stainless steel.
   c. Reinforced elastomer, having durometer hardness of 90 +/- 5 and meeting requirements of Article 2.10.3(L) of AASHTO Standard Specifications for Highway Bridges (1983).

2.11 REPAIR MATERIALS

A. Acceptable repair materials:
   1. Extended Open Time Epoxy Bonding Agent: Three-component, water based, epoxy modified portland cement bonding agent and corrosion inhibitor coating providing the recommended Manufacturer's open time in which to apply repair mortar. Product shall be capable of achieving bond strength of 2,700 psi per ASTM C 882.
      a. "Duralprep A.C.", by The Euclid Chemical Company, Cleveland, OH.
      b. "Emaco P24", by BASFBuilding Systems, Shakopee, MN.
      c. "Sika Armatec 110 EpoCem", by Sika Corporation, Lyndhurst, NJ.
      d. "Planibond 3-C" or "Mapefer 1K", by Mapei Corporation, Deerfield Beach, FL.
   2. Epoxy Adhesive: 2 or 3 component, 100 percent solids, 100 percent reactive compound suitable for use on dry or damp surfaces:
      a. "Euco #452 Epoxy Series", or "Duralcrete Epoxy Series", by The Euclid Chemical Company, Cleveland, OH
      b. "Emaco P24", or "Concresive Liquid LPL", by BASF Building Systems, Shakopee, MN.
      c. "Sikadur 32 Hi-Mod LPL" by Sika Corporation, Lyndhurst, NJ.
   3. Trowel Applied Repair Mortar: Shall be prepackaged polymer-modified cementitious repair mortar capable of vertical/overhead application by trowel achieving a minimum 3,000 psi compressive strength at 7 days and 5,000 psi compressive strength at 28 days per ASTM C 109 as certified by manufacturer. All patches shall be squared or rectangular in shape with ½" deep sawcut edges, except at locations of reinforcement or tendons. Minimum repair thickness shall be ½" unless specified greater by the manufacturer and maximum lift thickness according to manufacturer requirements.
      a. "EMACO R Series", "Thorite Rapid Vertical", or HBA or HB2 Repair Mortars", by BASF Building Systems, Shakopee, MN.
      b. "Duraltop Gel", "Speedcrete PM", or "Verticoat", by The Euclid Chemical Comany, Cleveland, OH.
      c. "SikaRepair 223 with Latex R", "SikaRepair SHB with Latex R", or SikaRepair SHA with Latex R", by Sika Corporation, Lyndhurst, NJ.
      d. "Planitop 23" by MAPEI Corporation, Deerfield, FL.
   4. Horizontal Repair Mortar: Shall be prepackaged polymer-modified, cementitious repair mortar capable of horizontal, pour and screed, form and pour, partial depth, partial and full depth, or full depth applications. Material shall achieve a minimum 3,000 psi compressive strength at 7 days and 5,000 psi compressive strength at 28 days per ASTM C109 if neat and ASTM C39 if extended as certified by manufacturer. Manufacturer shall submit volume and size of SSD aggregate used for mix extension. All patches shall be squared or rectangular in shape with ½" deep sawcut edges, except at locations of reinforcement or tendons. Minimum thickness shall be ½" and maximum thickness of placement according to manufacturer requirements.
      a. "Duraltop Flowable Mortar", by The Euclid Chemical Company, Cleveland, OH.
      b. "Emaco S66 CI", or "Emaco R310 CI", by BASF Building Systems, Shakopee, MN.

c. “SikaTop 111 Plus”, “Sikatop 122 Plus”, or Sika Repair 222 with Latex R”, by Sika Corporation, Lyndhurst, NJ.
d. “LS-S6 or S10” or “LM-S6 or S10”, by King Packaged Materials Company, Burlington, ON.
e. "Topcem Premix with Planitop AC”, by MAPEI Corporation, Deerfield Beach, FL.

5. Immediate upon conclusion of finishing operation cure concrete in accordance with ACI 308 for duration of at least seven days by moisture curing or moisture retaining covering. Provide additional wet curing immediately following initial curing and as necessary before concrete has dried.
   a. Continue method used in initial curing.
   b. Material conforming to ASTM C171.
   c. Other moisture retaining covering as approved by Engineer.
   d. During initial and final curing periods maintain concrete above 50°.
   e. Prevent rapid drying at end of curing period.

2.12 CONCRETE MIXTURES

A. Proportion mixtures determined by either laboratory trial mix or field test data bases, as follows:
   1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
   2. Provide different mixtures as the season warrants, as well as each type and strength of concrete or for different placing methods.

B. Use a qualified independent testing agency for preparing and reporting proposed Mixture Proportions for the laboratory trial mix basis.

C. Requirements for normal-weight concrete mix are shown on Drawings:
   1. Compressive strength
   2. Slump
   3. Water-cementitious materials ratio

D. Supplementary cementitious materials: For concrete exposed to deicers, limit percentage, by weight, of cementitious materials according to ACI 318 requirements.

E. Supplementary cementitious materials: Maximum weight of fly ash, natural pozzolans, processed ultrafine fly ash or slag included in concrete shall not exceed percentages of total weight (see footnotes for ACI 301 Part 4 Table “Requirements for Concrete Exposed to Deicing Chemicals”) of cementitious materials as follows:
   1. Fly Ash or other pozzolans conforming to ASTM C 618: 25 percent.
   2. Slag conforming to ASTM C 989: 50 percent.
   3. Processed ultra fine fly ash conforming to ASTM C 618: 15 percent.
   4. Total of fly ash or other pozzolans and slag: 50 percent.

F. Chloride Ion Content of Mixture:
   1. Water soluble chloride ion content of concrete shall not exceed 0.06 percent by weight of cement for pre-stressed concrete and 0.15 percent for reinforced concrete. (ACI 318 Chapter 4 Table 4.4.1“Maximum Chloride Ion Content for Corrosion Protection of Reinforcement”) Test to determine chloride ion content shall conform to ASTM C 1218.

2. Concrete chloride ion content shall be determined by Testing Agency prior to placement. Cast samples from current production of concrete mix proposed for superstructure.
3. Concrete not meeting the requirements of paragraph “Water soluble chloride ion content of concrete…” above, shall contain appropriate amount of calcium nitrite. Concrete supplier shall provide laboratory test results showing the amount of excess chloride ion content in the concrete mixture contributed by the aggregates. For each pound of chloride ion in excess of the amount allowed, mix shall contain calcium nitrite (30 percent, plus or minus 2 percent, solids content) on one-to-one basis (one gallon of calcium nitrite for one lb of excess chloride ion). Calcium nitrate used to offset chloride ions is in addition to calcium nitrate used as a corrosion inhibitor. Maximum of 1.5 lb of chloride ion per cubic yard may be offset in this manner.

G. Alkali-Aggregate Reactivity Resistance: Provide one of the following:
1. Total equivalent alkali content of mixture less than 5 lb/cu. yd.
2. ASTM C1293: Expansion less than 0.04 % after 1 year for each of the aggregates (both coarse and fine) in the proposed concrete mixture. This data shall be less than 1 year old.
3. ASTM C1260: Expansion less than 0.1 % after 14 days for each of the aggregates (both coarse and fine) in the proposed concrete mixture.
4. ASTM C1567: Expansion less than 0.1 % after 14 days with each of the aggregates (both coarse and fine) and the supplementary cementing materials (both source and quantity) of the proposed concrete mixture design. Alternatively, if satisfactory ASTM C1260 test results can be provided for one of the aggregates that are being used, ASTM C1567 testing does not need to be provided for that aggregate.
5. CE CRD-C662: Expansion less than 0.1 % after 28 days with the each of the aggregates (both coarse and fine), the supplementary cementing materials (both source and quantity) of the proposed concrete mixture design and the lithium admixture source and dosage level of the proposed mixture design. Alternatively, if satisfactory ASTM C1260 test results can be provided for one of the aggregates that are being used, CRD-C662 testing does not need to be provided for that aggregate.

H. Synthetic Fiber (collated fibrillated or monofilament): Uniformly disperse in concrete mix at manufacturer’s recommended rate, but not less than 1 lb/cu. yd.

I. Admixtures: Use admixtures according to manufacturer’s written instructions.

1. Consider using water-reducing admixture or high-range water-reducing admixture (Superplasticizers), OR admixtures that achieve self-consolidating concrete, as required, for placement, workability, finishing and when required, increased flowability.
2. Consider using water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use high range water-reducing admixture in pumped concrete, concrete for parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio of 0.45 or less. Use normal or mid-range water reducing admixture for concrete with water-cementitious materials ratio greater than 0.45.

J. Slump (ACI 301, Part 4 header “Slump”):

1. Maximum slump for concrete is indicated on Drawings. Where field conditions require slump to exceed that shown, increased slump shall be obtained by use of high range water reducers (superplasticizers) only, and Contractor shall obtain written acceptance from Engineer who may require an adjustment to mix.
2. All concrete containing high-range water-reducing admixture (superplasticizer) shall have a verified initial slump of 2– 3 in. Final slump after the addition of the superplasticizer shall be 6–9 in. as required by the contractor to properly place the concrete. Before permission for plant addition of superplasticizer to be granted by Engineer, fulfill following requirements:
    a. Submit letter from testing laboratory which developed original mixture proportions, for each superplasticized mixture, certifying volume of mix water which will produce specified slump and water/cement ratio, taking into account aggregate moisture content.
    b. Submit plant computer printout of mixture ingredients for each truckload of superplasticized concrete with delivery of that truckload. Mix water volume greater than that certified shall be cause for concrete rejection.
    c. Over-retarding or crusting of flatwork surface: cause for concrete rejection.
    d. Segregation or rapid slump loss (superplasticizer life) due to incompatibility or under-dosing: cause for concrete rejection.

K. Shrinkage (Length Change):

1. Determine length change of hardened concrete test specimens in accordance with ASTM C 157, except as noted in paragraph below. Existing test data from previous project with same materials may be acceptable.
2. Test specimens shall be moist cured, including period in molds for 7 days. Then store specimens in air for period of 28 days.
3. Utilize concrete materials and mix proportions submitted, for use in floor slab beam, in accordance with Part 1 Article “Submittals”.
4. Report length change of specimens after periods of air drying after curing of 4, 7, 14, 21, and 28 days.
5. Average length change after 28 days shall be limited to 0.04%, unless otherwise accepted by Engineer. Values exceeding 0.04% shall be rejected.

L. Self-Consolidating Concrete:

1. Minimum flow of 24 in. to 28 in. or as required by the successful test placement. All self-consolidating concrete shall contain the specified high-range water-reducing admixture and viscosity-modifying admixture as required.
2. Measure slump flow using slump cone upright or inverted in accordance with ASTM C1611. Measured flow shall be greater than 24 inches and consistent with submitted mixture test parameters plus or minus 2 in.
3. Measure passing ability in accordance with ASTM C 1621/C 1621M. Use the slump cone in the same way as in the slump flow test. Difference in average slump flow between slump flow and passing ability tests shall not exceed 2 in.
4. Determine the static segregation (stability) in accordance with ASTM C 1610/C 1610M. Segregation factor of the mixture shall not be more than 15 percent.

M. Engineer’s acceptance of mixture proportions shall not relieve Contractor from responsibility for any variation from requirements of Contract Documents unless

Contractor has in writing called Engineer's attention to each such variation at time of submission and Engineer has given written approval of each such variation.

N. Adjustment to Concrete Mixtures: Adjustments to mixture proportions may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mixture and strength results shall be submitted to and accepted by Engineer before using in work.

2.13 FABRICATING REINFORCEMENT

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

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch plant-printed ticket information at delivery to site.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Provide plant-printed batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mixture identification number, date, time of batching, mixing time, quantity and details of materials, amount of water introduced and water permitted by plant to be added, if any.

C. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd. increase mixing time by 15 seconds for each additional 1 cu. yd.
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, mixture identification number, date, time of batching, mixing time, quantity and details of materials, and amount of water added. Record approximate location of final placement in structure.

2.15 TOOLS

A. Slab Jointing

1. Concrete groovers: For tooled joints in concrete:

a. For concrete not exceeding 4 in. thickness, use groover with 1 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.
b. For concrete exceeding 4 in. thickness, use groover with 1.5 in. deep v-cut bit, 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.

2. Saw Cut Joints:

a. Acceptable tool: “Soff-Cut Saw Model 310” or “Model G2000,” Soff-Cut International, Corona, CA.

1) Cut joint as soon as concrete will support weight of operator and saw without deforming.
2) Joint shall be 1 in. deep for concrete thickness of 4 in. or less. Joint shall be 1.5 in. deep for concrete exceeding 4 in. thickness. Do not cut reinforcement.
3) Extend joint to adjacent vertical surface within 30 minutes of cutting.
4) Retool or grind sawcut joint before installing sealant to provide equivalent dimensions, shape and volume as joint obtained by tooled joint. Surface width shall be 0.5 in. with 3/16 to 1/4 in. edge radius.
5) All joints subject to acceptance by sealant installer. Rework rejected joints until acceptable to sealant installer.

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 concrete structure can support such loads and in accordance with Article 1.5 “Contractor’s Professional Services – Performance and Design Criteria”.

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

1. Drilled Pier Caps and Pile Caps:

a. Variation of center from specified plan location: 0.5 in.
b. Variation of bearing surface from specified location: Plus or minus 0.5 in.
c. Variation from specified dimensions in plan: Plus 2 in. minus 0 in.
d. Variation decrease from specified thickness: 0.5 in.

2. Footings:

a. Footings other than those to receive masonry construction: Variation of bearing surface from specified elevation: Plus or minus 0.5 in.
b. Footings to Receive Masonry Construction:
1) Variation of center from specified location in plan: Plus or minus 0.25 in. in any 10 ft but not to exceed plus or minus 0.5 in.
2) Variation of bearing surfaces for specified elevation: Plus or minus 0.25 in. in any 10 ft but not to exceed plus or minus 0.5 in.

3. Piers, Columns, Walls, Beams, and Slabs:

a. Variation in cross-sectional dimensions of piers, beams and columns and in thickness of walls and slabs: 12 in. or less: Plus 0.375 in., minus 0.25 in. Greater than 12 in.: Plus 0.5 in., minus 0.375 in.
b. Variation in elevation from specified elevation for piers, columns and walls: Plus or minus 0.5 in.

4. Anchor bolts: concrete contractor shall place anchor bolts within tolerances stated under heading “Anchor Bolts and Bearing Plates” of PCI “Code of Standard Practice for Precast Concrete.”

C. Void Forms:

1. Protect all forms from moisture prior to concrete placement.
2. Install all forms and accessories in accordance with manufacturer’s recommendations.
3. Protect all forms from puncture and moisture during concrete placement including accessories such as taped joints, seam pads and end caps.

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. Kerf wood inserts for easy removal.
3. 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.

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 bolts, accurately located, to elevations required.
2. Install reglets to receive top edge of foundation sheet 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 as indicated.

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 for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:

1. At least 70 percent of 28-day design compressive strength.
2. For post-tensioned concrete, formwork shall remain in place until post-tensioning has been completed. Do not place additional loads on structure until concrete has been properly reshored.
3. Specified compressive strength of 5000 psi. Determine compressive strength of in-place concrete by testing representative field cured test specimens according to ACI 301.
4. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. 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.

D. 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 SHORES AND RESHORES

A. Comply with ACI 347.2, ACI 318 and ACI 301, for design, installation, and removal of shoring and reshoring and in accordance with Article 1.5 “Contractor’s Professional Services – Performance and Design Criteria”.

1. Do not remove shoring until measurement of slab tolerances is completed.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 VAPOR BARRIER

A. Vapor Barrier: Place, protect, and repair vapor-barrier or vapor sheets according to ASTM E 1643 and manufacturer’s written instructions.

3.6 STEEL REINFORCEMENT

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

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

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

1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.

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

E. Install welded wire reinforcement in longest practicable lengths on continuous bar supports spaced at 2 ft o.c., maximum. Lap edges and ends of adjoining sheets per ACI 318 and as follows:

1. Length of overlap measured between outermost cross wires of each sheet shall not be less than one spacing of cross wires plus two inches nor less than one and one-half times the development length nor 6 in. minimum where development length is calculated per section 12.8 of ACI 318.
2. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

F. Splices:

1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.
2. For mechanical tension splices of reinforcement:
    a. Column bar lengths shall not exceed 30 ft between splices. In any bar, no splices shall occur at any floor level.
    b. Exercise care to assure that no reduction of cross-sectional area of reinforcement occurs.
    c. For all mechanical splices, perform splicing in strict accordance with manufacturer's requirements and instructions.
    d. Stagger splices in adjacent bars.
    e. Except where shown on Drawings, welding of reinforcement prohibited without prior written authorization by Engineer.
3. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.
4. Welded wire reinforcement shall not extend through contraction joints.

3.7 JOINTS

A. Joints in Concrete (ACI 301, Section 5):

1. Construction, control and isolation joints are located and detailed on Drawings:
    a. Tool joints at time of finishing. Tool: Part 2 Article "Tools."
    b. Saw Cut Joints:
        1) Cut joint as soon as concrete will support weight of operator and saw without deforming.

2) Joint shall be 1 in. deep for concrete thickness of 4 in. or less. Joint shall be 1.5 in. deep for concrete exceeding 4 in. thickness. Do not cut reinforcement.
3) Extend joint to adjacent vertical surface within 30 minutes of cutting.
4) Retool or grind saw cut joint before installing sealant to provide equivalent dimensions, shape, and volume as joint obtained by tooled joint. Surface width shall be 0.5 in. with 3/16 in. to 1/4 in. edge radius.
5) All joints subject to acceptance by sealant installer. Rework rejected joints until acceptable to sealant installer.

c. Isolation joints: Interrupt structural continuity resulting from bond, reinforcement or keyway.
d. Construction and control joints in walls: Space joints at 20 ft. on center unless smaller spacing is shown on Drawings.
e. Construction or control joints in floor slabs on ground: Maximum slab area controlled by jointing 400 sq ft. Space joints at 20 ft. on center maximum unless different spacing is shown on Drawings.
f. Coordinate configuration of tooled joints with control joint sealants.

B. Provide keyways at least 1-1/2 in. deep in construction joints in walls and slabs. Accepted bulkheads designed for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Do not continue reinforcement through sides of strip placements.

D. Use bonding grout, containing the specified bonding admixture, on existing concrete surfaces that will be joined with fresh concrete.

E. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

1. Joint filler and sealant materials are specified in Division 7 Sections of these Specifications.

F. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown.

1. Tool contraction joints.
2. If joint pattern not shown, provide joints not exceeding 20 ft in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

G. Joint sealant material is specified in Division 7 Sections.

3.8 WATERSTOPS

A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer’s written instructions.

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

3.9 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 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 mix.

C. Deposit concrete continuously or in 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 specified. Deposit concrete to avoid segregation.

D. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically (in thin slabs vibrator may be inserted at angle or horizontally to keep vibrator head completely immersed) inserted at uniformly spaced locations no farther than 1.5 times action radius so area visibly affected by vibrator overlaps adjacent previously vibrated area by 3-4 inches. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration (usually 5 to 15 seconds) of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge or motor driven vibrating screed and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using highway bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. 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 air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
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. Use only the specified non-corrosive accelerator. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mixture proportions.

G. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F 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. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.10 FINISHING FORMED SURFACES

A. Refer to Section 033300.

3.11 FINISHING FLOORS AND SLABS

A. Flatwork in Parking and Drive Areas (BROOM Finish, ACI 301, Section 5 header "Broom or Belt Finish":

1. Bullfloat immediately after screeding. Complete before any excess moisture or bleed water is present on surface (ACI 302.1R, Article 8.3.3). The use of power trowels is discouraged; however, if they are used the following applies:
    a. Use minimal passes so as to not overwork the concrete.
    b. At the contractor's expense a petrographic analysis will be required in each area where a power trowel is used to verify the air content at the slab surface is within specified limits.
    c. After excess moisture or bleed water has disappeared and concrete has stiffened sufficiently to allow operation, give slab surfaces coarse transverse scored texture by drawing broom across surface. Texture shall be as accepted by Engineer from sample panels.
2. Finish tolerance: ACI 301, Paragraph 5.3.4.2 and ACI 117, paragraph 4.5.7: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5 in. In addition, floor surface shall not vary more than plus or minus 0.75 in. from elevation noted on Drawings anywhere on floor surface.
3. Before installation of flatwork and after submittal, review, and approval of concrete mixture proportions, Contractor shall fabricate two acceptable test

panels simulating finishing techniques and final appearance to be expected and used on Project. Test panels shall be minimum of 20 ft. by 30 ft. in area and shall be reinforced and cast to thickness of typical parking and drive area wearing surface in Project. (Maximum thickness of test panels need not exceed 6 in.) Test panels shall be cast from concrete supplied by similar concrete batch, both immediately after addition of superplasticizer or water-reducing admixture, and at maximum allowed time for use of admixture-treated concrete in accordance with Specifications. Intent of test panels is to simulate both high and low workability mixes, with approximate slump at time of casting of test panels to be 6 in. and 3 in., respectively. Contractor shall finish panels following requirements of paragraphs above, and shall adjust finishing techniques to duplicate appearance of concrete surface of each panel. Finished panels (one or both) may be rejected by Engineer, in which case Contractor shall repeat procedure on rejected panel(s) until Engineer acceptance is obtained. Accepted test panels shall be cured in accordance with Specifications and may be incorporated into Project. Accepted test panels shall serve as basis for acceptance/rejection of final finished surfaces of all flatwork.

4. Finish all concrete slabs to proper elevations to ensure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. Contractor shall bear cost of any corrections to provide for positive drainage.

B. Flatwork in Stairtowers and enclosed, Finished Areas (Float Finish, ACI 301, Paragraph 5.3.4.2.b):

1. Give slab floated finish. Texture shall be as accepted by Engineer from sample panels.
2. Finishing tolerance ACI 301, Section 5 header “Measuring Tolerances for Slabs” and ACI 117, paragraph 4.5.7: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5 in. In addition, floor surface shall not vary more than plus or minus 3/8 in. from elevation noted on Drawings anywhere on floor surface.

C. Flatwork in Stair towers and Parking Garage floor subject to pedestrian traffic:

1. Refer to Section 033300.

3.12 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 Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still workable 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 of manufacturer furnishing machines and equipment.

3.13 CONCRETE PROTECTION AND CURING

A. General: Comply with ACI 308.1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Reducer: Apply evaporation reducer to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft./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. Do not finish immediately after evaporation reducer applied. Wait until after (green, if Confilm used – pink, if Eucobar used) film disappears.

C. Formed Surfaces: Cure formed concrete surfaces of columns, walls, and upturned beams. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing 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. Tepid (within 20 deg F of concrete temperature) water.

   b. Continuous water-fog spray.

   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch 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, 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.
3. Curing Compound: After Moisture or Moisture-Retaining-Cover Curing, 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. Apply two separate coats with first allowed to become tacky before applying second. Direction of second application shall be at right angles to direction of first.

   b. Curing compound prohibited when concrete has specified water-cementitious materials ratio less than or equal to 0.40 or air temperature above 80 deg F. Use moist cure instead.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, 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. Tepid (within 20 deg. F of concrete temperature) water.

   b. Continuous water-fog spray.

c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch 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, 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 recommends for use with floor coverings.

3. Curing Compound: Where permitted, apply uniformly in continuous operation by power spray or roller immediately after final finishing and the absence of surface moisture, 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. Apply two separate coats with first allowed to become tacky before applying second. Direction of second application shall be at right angles to direction of first.

   b. Curing compound prohibited when concrete has specified water-cementitious ratio less than or equal to 0.40 or air temperature above 80 deg F. Use moist cure instead.

   c. Removal: If curing compounds are used on surfaces (exterior or interior, formed or unformed) that are scheduled or specified to receive surface-adhered treatment (including but not limited to cementitious toppings/overlays, adhesive applied carpet, resilient flooring, terrazzo, thin-set ceramic tile/stone, wood, coatings, paint, waterproofing, membranes, athletic flooring, epoxy overlay/adhesive, hardeners, sealers, water repellents, or other covering system adhered with water-based adhesive), then the following requirements apply:

      1) Remove curing compound no later than 7 days after end of curing period by mechanical bead blast process acceptable to Architect.

      2) Allow sufficient additional time after curing compound removal to achieve proper concrete moisture and/or water vapor limitation for successful application of subsequent surface treatment as specified in appropriate surface treatment specification Section.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Engineer/Architect. Remove and replace concrete that cannot be repaired and patched to Engineer/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 sieve, using only enough water for handling and placing. Use this repair procedure only with Engineer/Architect approval.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than ½ inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with specified bonding agent. Fill and compact with specified patching mortar before specified bonding agent has dried. Fill form-tie voids with specified patching mortar or cone plugs secured in place with specified 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 on mockup, or if none, 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 Engineer/Architect.
4. Repair isolated random cracks that have little movement and single holes not over 1 in. in diameter in accordance with procedures and materials specified in Division 7 Section "~~Concrete~~ Joint Sealants." Receive Engineer's written acceptance of methods and materials selected prior to application.

    a. Repair isolated random horizontal cracks less than 0.01 in. wide, using silane sealer product specified in Division 7 "Water Repellants"

    b. Repair isolated random horizontal cracks 0.01 in. to less than 0.03 in. wide, using crack sealer product specified in Division 7 "Water Repellants."

    c. Repair isolated random horizontal cracks 0.03 in. to 0.06 in. wide: route and seal with specified sealant product in Division 7 "~~Concrete~~ Joint Sealants."

    d. Repair isolated random vertical cracks more than 0.01 in. wide, using epoxy injection product specified in part 2 heading "Related Materials" of this section.

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.

1. Repair finished surfaces containing defects. Surface defects include spalls, pop-outs, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
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.
4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of ¼ inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete or latex modified concrete as approved by the Engineer. Remove defective areas with clean, square cuts and expose steel reinforcement with at least ¾ inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
6. Repair single holes 1 inch or less in diameter with patching mortar. Cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
7. Repair isolated random cracks that have little movement and single holes not over 1 in. in diameter in accordance with procedures and materials specified in Division 7 Section "~~Concrete~~ Joint Sealants." Receive Engineer's written acceptance of methods and materials selected prior to application.

    a. Repair isolated random horizontal cracks less than 0.01 in. wide, using silane sealer product specified in Division 7 "Water Repellants"

    b. Repair isolated random horizontal cracks 0.01 in. to less than 0.03 in. wide, using crack sealer product specified in Division 7 "Water Repellants."

    c. Repair isolated random horizontal cracks 0.03 in. to 0.06 in. wide: route and seal with specified sealant product in Division 7 "Concrete Joint Sealants."

    d. Repair isolated random vertical cracks more than 0.01 in. wide, using epoxy injection product specified in part 2 heading "Related Materials" of this section.

E. Perform structural repairs of concrete, subject to Engineer/Architect's approval, using epoxy adhesive and patching mortar, latex modified concrete or other materials as approved by the Engineer.

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

3.15 FIELD QUALITY CONTROL

A. CM At Risk will employ a testing laboratory to perform tests and to submit test reports.

B. Sample concrete in accordance with ASTM C 172.

C. Temperature:

1. Test temperature of concrete in accordance with ASTM C 1064/C 1064M and ACI 301 each time cylinders are taken or as directed by the Engineer.

D. Slump Test:

1. Conduct one slump test in accordance with ASTM C 143/C 143M per truck load of ready-mixed concrete delivered to Project at truck for superstructure concrete.
2. Conduct slump test in accordance with ASTM C143/C 143M and ACI 301 for foundation concrete.
3. When high-range water-reducing admixture (superplasticizer) is used, initial slump must be verified by Testing Agency.

E. Slump Flow Test (SCC):

1. Conduct one slump flow test in accordance with ASTM C 1611/C 1611M per truck load of ready mixed concrete delivered to Project at truck for superstructure concrete.
2. Conduct slump flow test in accordance with ASTM C1611/C 1611M and ACI 301 for foundation concrete.

F. Water Content:

1. Water content and water-cementitious materials ratio shall be verified by use of the Microwave Test in accordance with AASHTO T 318.
2. Conduct test each time test cylinders are taken and as directed by Engineer.

G. Concrete Compressive Strength:

1. Mold test cylinders in accordance with ASTM C 31 and test in accordance with ASTM C 31 as follows:
    a. Take minimum of six cylinders (eight for post-tensioned cast-in-place concrete) for each 100 cu yd or fraction thereof, of each Mixture of concrete placed in any one day.
    b. Additional cylinders shall be taken under conditions of cold weather concreting per Part 3 Heading “Concrete Curing and Protection.”
    c. At Contractor’s option and cost, cylinders may be taken to verify concrete strength prior to form removal.
    d. Testing Agency: Provide and maintain site cure box for cylinders.
2. Sample plastic concrete for testing at point of final placement, in accordance with ASTM C 172. Engineer will select sampling locations which may include points where plastic concrete has already been screeded and floated. Sample concrete for test cylinders to be used to verify concrete compressive strength for post-tensioning as near as possible to actual tendon anchorages.
3. Cover specimens properly, immediately after finishing. Protect outside surfaces of cardboard molds, if used, from contact with sources of water for first 24 hours after molding.
4. Cure test cylinders per ASTM C 31 as follows:

a. To verify compressive strength prior to post-tensioning or form removal or for additional test cylinders required due to cold weather concreting conditions:

1) Store test specimens on structure as near to point of sampling as possible and protect from elements in same manner as that given to portion of structure as specimen represents.
2) Transport to test laboratory no more than 4 hours before testing. Remove molds from specimens immediately before testing.

b. To verify 28-day compressive strength:

1) During first 24 hours after molding, store test specimens under conditions that maintain temperature immediately adjacent to specimens in range of 60 to 80 degrees F. and prevent loss of moisture from specimens.
2) Remove test specimens from molds at end of 20 +/- 4 hours and store in moist condition at 73.4 +/- 3 degrees F. until moment of test. Laboratory moist rooms shall meet requirements of ASTM C 511.

5. Compression test for non-prestressed concrete:

a. Test 2 cylinders at 7 days.

b. Test 2 cylinders at 28 days.

c. Test 2 cylinders at 56 days for concrete strength requirement of 7000 psi or greater, otherwise hold 2 cylinders in reserve for use as Engineer/Architect directs.

6. Compression tests for post-tensioned concrete:

a. Test 2 cylinders immediately before tensioning slabs and 2 cylinders before tensioning beams. Cylinders must be field cured in accordance with paragraph “Cure test cylinders per ASTM C 31….”

b. Test 2 cylinders at 28 days.

7. Hold 2 cylinders in reserve for use as Engineer directs.
8. Unless notified by Engineer, reserve cylinders may be discarded without being tested after 56 days.

H. Report all nonconforming test results to Engineer and others on distribution lists via fax or email. Follow up with colored paper copies to flag the non-conformances.

I. Monthly, submit a graph showing distribution of compressive strength test results and air content test results. Include microwave test results for concretes with a water cementitious ratio less than or equal to 0.40 concrete.

EVALUATION AND ACCEPTANCE OF CONCRETE

J. Concrete Compression test will be evaluated by Engineer in accordance with ACI 301. If number of tests conducted is inadequate for evaluation of concrete or test results for any type of concrete fail to meet specified strength requirements, core tests may be required as directed by Engineer. Air content and parameters of air-void system shall meet requirements of this Section.

K. Core tests, when required, in accordance with ASTM C42 and ACI 301.

L. Should tested hardened concrete meet Specifications, Owner will pay for coring and testing of hardened concrete. Should tested hardened concrete not meet Specifications or should concrete have to be tested because Contractor did not conform to Project specifications, Contractor shall pay for coring and testing of hardened concrete and for any corrective action required for unaccepted concrete.

3.16 ACCEPTANCE OF STRUCTURE

A. Acceptance of completed concrete Work will be according to provisions of ACI 301.

B. “RAPIDLOAD” testing is acceptable, by Structural Preservation Systems, Baltimore, MD.

END OF SECTION

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

I. GENERAL INFORMATION:	
Project:	City:
General Contractor:	
Concrete Supplier:	
Mixture Identification No.:	Concrete Grade:
Use (Describe)[1]:	

[1] example: Footings, interior flatwork, floor slabs, topping, columns, etc.

II. MIXTURE PROPORTIONING DATA:		
Proportioning Based on (Check only one): Standard Deviation Analysis: _____(see section VIII) or Trial Mix Test Data: _____ (see Section IX)		
Mixture Characteristics: (see Mixtures in Drawings General Notes)	Density: pcf;	Air: % specified
	Slump ____ in. before superplasticizer	Slump ____ in. after superplasticizer Or for SCC: Spread ____ in.
	Strength: _____ psi (28 day);	

WALKER SUBMITTAL STAMP

CONTRACTOR SUBMITTAL STAMP

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

III. MATERIALS:		
Aggregates: (size; type; source; gradation report; specification)		
Coarse:		
Fine:		
Other Materials:	Type	Product-Manufacturer (Source)
Cement:		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processed Ultra Fine Fly Ash		
HRM		
Air Entraining Agent:		
Water Reducer		
High Range Water Reducer (HRWR / superplasticizer)		
Non-Corrosive Accelerator		
Retarder		
Fibers		
Other(s):		

IV. MIX PROPORTIONS (2)		
	WEIGHT (lbs.) (per yd^3)	ABSOLUTE VOL. (cu. ft.) (per yd^3)
Cement:		
Fine Aggregate: (3)		
Coarse Aggregate: (3)		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processes Ultra Fine Fly Ash		

HRM		
Water: (.4) (gals. & lbs)		
Entrained Air: (oz.)		
Fibers:		
(Other) _____:		

TOTALS:		

NOTES:

(2) Mix proportions indicated shall be based on data used in section VII or IX.

(3) Based on saturated surface dry weights of aggregates.

(4) Includes ALL WATER, including added water and free water contained on aggregates.

V. RATIOS			VI. SPECIFIC GRAVITIES
Water(1)	lb		Fine Aggregate:
____ =	____ =		
Cementitious Material(2)	lb		Coarse Aggregate:
Fine Agg.	lb		
____ =	____ =		
Total Agg.	lb		

NOTES:

(1)Includes ALL water, including added water and free water contained on aggregates.

(2)Cementitious materials include cement, fly ash, slag, silica fume, HRM, Processed Ultra Fine Fly Ash or other pozzolan.

VII. ADMIXTURES				
Air Entraining Agent (A.E.A.):	___ oz.	per yd^3	___ oz.	per 100# cement
Superplasticizer	___ oz.	per yd^3	___ oz.	per 100# cement
Water Reducer	___ oz.	per yd^3	___ oz.	per 100# cement
Non-corrosive Accelerator	___ oz.	per yd^3	___ oz.	per 100# cement
Retarder	___ oz.	per yd^3	___ oz.	per 100# cement
Other	___ oz.	per yd^3	___ oz.	per 100# cement
Lithium Nitrate	___ gal.	per yd^3		

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

VIII. STANDARD DEVIATION ANALYSIS:	Yes	N/A
(Complete this section only if Mixture was developed using standard deviation analysis of previous project test results. If other method was used, check "N/A".)		
Number of Tests Evaluated: (One test is average of two cylinder breaks) Attach copy of test data considered:	Standard Deviation: (Single Group) Standard Deviation: (Two Groups)	
Required average compressive strength: f'cr = f'c + _____ psi		

NOTE:

Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'cr equal to or greater than the larger of one of the following equations:

(4.-3) f'cr = f'c + 1.34ks [s= calculated standard deviation]

or

(4-4) f'cr = f'c + 2.33ks – 500

or

(4-5) f'cr = 0.9f'c + 2.33ks (for f'c> 5,000 psi)

(Refer to ACI 301 for required average when data are not available to establish standard deviation. For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.)

MIXTURE CHARACTERISTICS (As shown on drawings)	
Slump = _____ in.	Air Content = _____ %
Unit Wet Wt. = _____ pcf	Unit Dry Wt. = _____ pcf

MIXTURE CHARACTERISTICS (Based on proportioning data)	
Initial Slump = _____ in.	Final Slump _____ in.
Unit Wet Wt.= _____ pcf.	Unit Dry Wt. = _____ pcf.
Air Content = _____ %	

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

IX. TRIAL MIXTURE TEST DATA:	Yes	N/A
(Complete this section only if Mixture Proportion is based on data from trial test mixture(s) batched by testing agency or Contractor. If other method was used, check "N/A".)		

Age (days)	Mix #1 (comp. str.)	Mix #2 (comp. str.)	Mix #3 (comp. str.)
7			
7			
28			
28			
28			
28 day average compressive strength, psi			

NOTE:

Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength f'cr equal to or greater than the larger of one of the following equations:

(Less than 3000) f'cr = f'c + 1000

or

(3000 to 5000) f'cr = f'c + 1200

or

(Over 5000) f'cr = 1.1f'c + 700

For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.

MIXTURE CHARACTERISTICS (as shown on drawings)	
Slump = _____ in.	Air Content = _____ %
Unit Wet Wt. = _____ pcf	Unit Dry Wt. = _____ pcf

MIXTURE CHARACTERISTICS (Based on proportioning data)	
Initial Slump = _____ in.	Final Slump _____ in.
Unit Wet Wt.= _____ pcf.	Unit Dry Wt. = _____ pcf.
Air Content = _____ %	

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

X. OTHER REQUIRED TESTS		
Water Soluble Chloride Ion Content of mix:	_____ %(by weight of cement)	ASTM C 1218
Hardened Air Content (per ASTM C457):		
Air content: _____%	Air void spacing Factor ____in.	Specific surface: ____in^2/in^3
Chloride Ion Content of Concrete Mixture: ASTM C 1218		
Shrinkage (Length Change, Average) per ASTM C157:		
_____% @ 4 days	_____% @ 7 days	_____% @ 14 days
_____% @21 days	_____% @28 days	

XI. Remarks:

CONCRETE MIXTURE PROPORTIONS SUBMITTAL FORM

Mixture #

Project Name:

Ready Mix Concrete Supplier Information
Name:
Address:
Phone Number:
Date:
Main Plant Location:
Miles from Project Site:
Secondary or Backup Plant Location:
Miles from Project Site:

My signature below certifies that I have read, understood, and will comply with the requirements of this Section.

Signature_____

Typed or Printed Name

REQUIRED ATTACHMENTS	
	Coarse aggregate grading report
	Fine aggregate grading report
	Concrete compressive strength data used for calculation of required average strength and for calculation of standard deviation
	Chloride ion data and related calculations
	Admixture compatibility certification letter
	Shrinkage information per ASTM C157
	ASTM C 457
	Alkali Content Data and Calculations OR ASTM C1293, ASTM C1260, ASTM C 1567 or CE CRD-C662 Test report for each aggregate

SECTION 03 3801 - POST-TENSIONED CONCRETE - PARKING GARAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. In accordance with Contract Documents, provide all materials, labor, equipment, and supervision to fabricate and install all post-tensioning Work. Non-prestressed reinforcement shall conform to Division 03 Section, "Cast-in-Place Concrete."

B. Meet the requirements of ACI 301, ACI 318, ACI 423.7, CRSI MSP-2, and Contract Documents. In case of a conflict, meet the more stringent requirement.

C. Related work in other Sections related to Post-Tensioned Concrete:

1. Division 01 Section “Project Management and Coordination.”
2. Division 03 Section "Cast-in-Place Concrete (Parking Garage)."

1.3 REFERENCES

A. Field Reference: Keep a copy of the following reference in the Contractor’s field office.

1. PTI’s “Field Procedures Manual for Unbonded Single Strand Tendons”

B. American Concrete Institute (ACI):

1. ACI 301, “Specification for Structural Concrete.”
2. ACI 318, "Building Code Requirements for Structural Concrete."
3. ACI 347, "Recommended Practice for Concrete Formwork."
4. ACI 362.1R-12, “Guide for the Design of Durable Parking Structures.”
5. ACI 423.3R, "Recommendations for Concrete Members Prestressed with Unbonded Tendons."
6. ACI 423.7, “Specification for Unbonded Single-Strand Tendon Materials and Commentary.”

C. American Society for Testing and Materials (ASTM):

1. ASTM A416, "Specification for Uncoated Seven-Wire Strand for Prestressed Concrete."
2. ASTM E328, "Recommended Practice for Stress-Relaxation Tests for Materials and Structures."

D. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI MSP-2, "Manual of Standard Practice."

E. Post-Tensioning Institute (PTI):

1. PTI, "Guide Specifications for Post-Tensioning Materials."
2. PTI, "Performance Specification for Corrosion Preventive Coating."
3. PTI, "Specification for Unbonded Single Strand Tendons."

4. PTI, "Field Procedures Manual for Unbonded Single Strand Tendons."

F. Florida Building Commission:

1. FBC, "Florida Building Code."

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the tendon and anchor locations with Work of other Sections, including “Cast-in-Place Concrete.” Immediately inform Engineer/Architect of any potential interference.

B. Sequencing:

1. Deviations in the construction and stressing sequence shown on the Drawings are not permitted without written acceptance from Engineer/Architect.

C. Make submittals in accordance with requirements of Division 01 Section, “Shop Drawings, Product Data, and Samples~~Submittal Procedures~~:”

1. See requirements of Division 01 Section, “~~Submittal Procedures~~Shop Drawings, Product Data, and Samples,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.
2. See requirements of Division 01 Section, “Shop Drawings, Product Data, and Samples~~Submittal Procedures~~,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.5 ACTION SUBMITTALS

A. Product Data: For each product as indicated.

1. Corrosion Inhibiting Coating: Type and chemical analysis.
2. Sheathing: Type, material, density and thickness.
3. Anchorage Device: Type, material and size.
4. Coupler Device: Type, material and size.
5. Pocket Former: Type, material and size.
6. Sheathing Repair Tape: Type, material and width.
7. Encapsulation System: Type and materials.

B. Shop Drawings: Include the following prepared by or under the supervision of a qualified professional engineer:

1. Number, arrangement and designation of tendons.
2. Tendon profile and method of tendon support. Show tendon profiles at sufficient scale to clearly indicate tendon high and low points.
3. Tendon anchorage details including bundled tendon flaring.

C. Construction Manager is expected to employ qualified personnel to review submittals before they are submitted to Engineer for review.

D. Resubmittals: Engineer will review each of Contractor’s submittals the initial time and, should resubmittal be required, again to verify that reasons for resubmittal have

been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions.

1. Make resubmittals in same form and number of copies as initial submittal.
   a. Note date and content of previous submittal.
   b. Note date and content of revision in label or title block and clearly indicate extent of revision.

E. Resubmit submittals until they are marked with approval notation from Engineer's and Construction Manager's action stamp

F. Samples: For the following products:

1. Each anchorage assembly with a minimum of 24 inches of coated, sheathed strand.
2. Each coupler assembly with a minimum of 24 inches of coated, sheathed strand.
3. Encapsulation system.

G. Delegated-Design: For post-tensioning system.

1. Signed and sealed calculations prepared by a qualified structural engineer in the State of Florida indicating method of elongation and determination of number of tendons. Include values used for friction coefficients, anchorage seating loss, elastic shortening, creep, relaxation, wobble and shrinkage.

H. Stressing Records: Same day as stressing operation.

I. Sustainable Design Documentation Submittals: Refer to section 01 8113.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Leadership Extraction Practices for Recycled Content for records

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Supplier and Installer at least 14 days prior to bid date using the forms at the end of this section.

B. Mill Test Reports: Certified mill test reports for each coil or pack of strand used on Project, indicating that strand is low relaxation and including the following information:

1. Heat number and identification.
2. Minimum breaking strength.
3. Yield strength at 1 percent extension under load.
4. Elongation at failure.
5. Modulus of elasticity.
6. Diameter and net area of strand.

C. Test and Evaluation Reports: Indicating compliance with the following requirements:

1. Tests required by ACI 301, Section “Post-Tensioned Concrete.”

2. Hydrostatic tests required by ACI 423.7 for “Anchorages and couplers in aggressive environments.”
3. Relaxation loss tests required by ACI 423.7 for low relaxation prestressing steel.

D. Field Quality-Control Reports: Within 72 hours of inspection.

E. Stressing Jack Calibration: Calibration certificates for jacks and gages to be used on Project. Calibrate each jack-and-gage set as a pair.

F. Warranty: Proposed warranty prior to the start of construction.

1.7 QUALITY ASSURANCE

A. Supplier Qualifications:

1. Use a fabricating plant certified by PTI.
2. Successfully provided all materials for at least 5 post-tensioning installations in parking structures in the United States with a structural system similar to Project within the previous 5 years. Provide all information requested on the form at the end of this section.

B. Installer Qualifications:

1. Certified by PTI.
2. Successfully performed at least 5 post-tensioning installations in parking structures in the United States with a structural system similar to Project within the previous 5 years. Provide all information requested on the form at the end of this section.
3. Use a full-time Project superintendent that has supervised at least 5 projects of similar magnitude.
4. Use PTI Certified Field Installers to install and stress post-tensioning system.

C. Suppliers, who do not meet the qualification requirements above, shall meet and pay for following requirements:

1. Retain independent testing or consulting firm acceptable to Engineer/Architect.
2. Acceptable firm shall inspect post-tensioning Supplier’s plant at 1 wk intervals during production and issue report on each visit, signed and sealed by Florida Licensed Professional Engineer verifying that materials, methods, product, and quality meet all PTI Plant Certification and Project specification requirements. Sample tendon corrosion preventive coating being applied during each visit and send sample directly to Engineer/Architect-designated testing laboratory for testing.
3. If firm’s report indicates noncompliance, Engineer/Architect, at Owner’s expense, may inspect and may reject any or all products produced during period of noncompliance.

D. Comply with requirements in ACI 301, Section “Post-Tensioned Concrete.”

E. Perform all post-tensioning Work under the supervision of a Project Superintendent who is present during all operations including installation, concrete placement, stressing and finishing.

1.8 DELIVERY, STORAGE AND HANDLING

A. Assign all tendons in same member the same heat number and identify accordingly.

B. Package each tendon bundle at source to prevent physical damage to tendon during transportation and storage, and to protect strand from moisture. Use heavy padding cardboard is not permitted. Do not use wire binding or other materials that could cut the sheathing or tendon.

C. Deliver, store and handle post-tensioning materials according to ACI 423.7. Contractor to inspect tendons and accessory items at time of delivery to Project site, prior to off-loading. Notify post-tensioning supplier of observed damage prior to off-loading.

D. Immediately remove damaged components from Project site and replace at no cost to Owner.

E. Do not remove sheathing on stressing end until the day of stressing.

F. Materials Stored on Slabs:

1. Prior to final stressing of beams and slabs, do not store any materials on slab.
2. After final stressing of beams and slabs but before concrete has reached the specified 28-day strength, do not store materials on slab such that the weight exceeds 50 percent of the design live load.
3. After final stressing of beams and slabs and concrete has reached the specified 28-day strength, do not store materials on slab such that the weight exceeds the design live load.

1.9 WARRANTY

A. Provide a warranty from the Supplier that includes the following terms and provisions.

1. Warranty period of 5 years beginning with the date of Beneficial Occupancy.
2. Correct, at no expense to Owner, any defects that develop during the warranty period, which can be attributed to a defect in quality of product or workmanship.
3. All materials have been manufactured in accordance with the Project specifications.
4. Installation of materials, if under the control of the Supplier, has been according to the Project specifications.
5. Supplier is not responsible for damage or liability caused by the actions or omissions of others.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. System described in this Section intended to satisfactorily perform in ACI 362.1R-12 zone CC-II environment without long-term corrosion or other distress.

B. Engage a qualified professional engineer licensed in Florida to provide tendon quantity calculations and detail the tendon layout based on the following:

1. Provide the final effective forces indicated on the drawings, which are the stressing forces minus both the short- and long-term losses.

2. Do not exceed the maximum tensile stress in the tendon during the stressing operation. The maximum tensile stress is the smallest of the following:
   a. 80 percent of the specified tensile strength of the tendon.
   b. 94 percent of the specified yield strength of the tendon.
   c. Maximum value recommended by the tendon manufacturer.
3. Do not exceed 70 percent of the specified tensile strength after the anchors are seated.
4. Use PTI recommended values for friction and wobble coefficients unless test data is submitted to substantiate lower values.
5. Limit main slab tendon maximum spacing according to ACI 318, chapter “Prestressed Concrete,” heading “Slab Systems.”
6. For multi-span tendons, do not base the effective tendon force on the average stress for all spans. Calculate losses for each span independently.

2.2 PRESTRESSING TENDONS

A. Prestressing Strand: ASTM A416, Grade 270, uncoated, seven-wire, low-relaxation strand with minimum ultimate strength of 270 ksi.
   1. Manufactured by a single source.
   2. Strands manufactured outside United States subject to Engineer/Architect’s approval based on evidence of satisfactory performance in the United States during the previous 5 years.
   3. Use of high stress bar system instead of strand system is not permitted unless accepted in writing by the Engineer.
   4. Conform to ACI 423.7 for relaxation loss requirements.
   ~~4.~~ 5. There shall be 0% recycled steel for the strands

B. Tendon Sheathing: Seamless and extruded high density polypropylene or seamless and extruded high density polyethylene with a specific gravity greater than 0.95 conforming to ACI 423.7.
   1. Sufficient strength to withstand damage during fabrication, transport, installation, concrete placement and stressing.
   2. Minimum thickness of 50 mils (–0 mils +15 mils)
   3. Minimum inside diameter 0.03 inches greater than maximum strand diameter.
   4. Chemically stable without becoming brittle or softening over anticipated temperature range and service life of structure.
   5. Non-reactive with concrete, steel and corrosion inhibiting coating.
   6. Contrasting color of corrosion inhibiting coating to enhance visibility of damage. Black/dark colored sheathing is not acceptable.
   7. Annular space between sheathing and strand completely filled with corrosion inhibiting coating.
   8. Watertight including all connections and components over entire length.

C. Tendon Anchor: Non-porous casting free of sand, blow holes, voids and other defects meeting the testing and material requirements of ACI 423.7.

1. Plastic coated bearing plates sized in accordance with ACI 423.7, unless certified test reports substantiate comparable or superior performance, for transfer at minimum stressing concrete strength.
2. Capable of complying with PTI Guide Specification requirements for aggressive environments.
3. Capable of developing at least 95% of the actual ultimate strength of tendon.
4. Minimum wedge cavity opening of at least 0.19 inches larger than tendon diameter. Reaming of anchor wedge cavity is not permitted.
5. Wedges capable of precluding failure of tendon due to notching or pinching effects during static and fatigue load tests stipulated in ACI 423.7.
6. Provisions for a plastic cap which fits tightly and seals barrel end on stressing side of anchor.
7. Provisions for a plastic sleeve which prevents moisture infiltration into anchor casting or tendon sheathing on bearing side of anchor.

D. Coupler Assembly: Assembly of strands and wedges meeting the testing and material requirements of ACI 301.

1. Capable of complying with PTI Guide Specification requirements for aggressive environments.
2. Capable of developing at least 95 percent of the ultimate strength of tendon.
3. Wedges capable of precluding failure of tendon due to notching or pinching effects during static and fatigue load tests stipulated in ACI 423.7.

E. Encapsulation System: Watertight encapsulation along the entire length of tendon, including anchorages and couplers, when subjected to hydrostatic testing required in ACI 423.7 for aggressive environments.

1. Sleeve: Translucent plastic with a positive mechanical connection to anchorages capable of resisting 100 lbs. pulling force. Minimum 10 inches long and 4 inches overlap with sheathing, completely filled with corrosion inhibiting coating.
2. Anchor Cap: Translucent plastic with a positive mechanical connection to anchorages capable of resisting 100 lbs. pulling force. At intermediate anchorages, open to allow passage of strand.
3. Subject to the requirements provide one of the following systems:
    a. “Zero Void,” General Technologies, Inc.
    b. “Hayes Posi-Lock Plus,” Hayes Industries, Ltd.
    c. Accepted equivalent.

2.3 ACCESSORIES

A. Pocket Formers: Capable of completely sealing wedge cavity from intrusion of concrete or cement slurry; sized to provide at least a 2 inch recess and allow access for cutting strand tail.

1. If Zero Void encapsulation system in used, the “Zero Void Nail-Less Pocket Former” is required.

B. Anchorage Fasteners: Stainless-steel ring nails. Subject to the requirements use one of the following:

1. Clendenin Brothers, Baltimore, MD.
2. Swan Secure Products, Baltimore, MD.
3. R.J. Leahy Co., San Francisco, CA.
4. Accepted equivalent.

C. Sheathing Repair Tape: Elastic, self-adhesive, moisture-proof tape with a minimum width of 2 inches in contrasting color to tendon sheathing, and that is non-reactive with sheathing, corrosion inhibiting coating, or tendon. Subject to the requirements use one of the following:

1. “3M Tape No. 226,” 3M, St. Paul, MN.
2. “Polyken 826,” Berry Plastics Corp, Evansville, IN
3. “Tyco Adhesives No. 398,” Tyco Adhesives, Franklin, MA

D. Sheathing Repair Material: For nicks and cuts less than 0.25 inches use one of the following:

1. “Scotch-Weld DP-8005,” by 3M.
2. Accepted equivalent.

E. Corrosion inhibiting coating: Capable of meeting the requirements of ACI 423.7. Subject to the requirements use one of the following

1. "Greasrex K-218," ExxonMobil Oil Corp., Irving, TX.
2. “Red-i PT Coating Grease,” Lubricating Specialties Co., Pico Rivera, CA
3. “Renolit PTG,” Fuch’s Lubricant Co., Harvey, IL
4. “Royal PT-1 and PT-2 Corrosion Inhibiting Grease,” Troco Oil Co., Tulsa, OK

F. Tendon supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening tendons in place. Use tendon supports capable of meeting the requirements in CRSI’s “Manual of Standard Practice” and as follows:

1. Clearly marked to differentiate by height.
2. Capable of resisting overturning during construction operations.
3. Minimal contact with forms where concrete is exposed to view.
4. Do not cause voids or damage to surrounding concrete.
5. All-plastic supports conforming to CRSI Class 1 protection requirements and with a compressive strength higher than concrete.
6. Acceptable manufacturers:

    a. Aztec Concrete Accessories, Inc.
    b. General Technologies, Inc.
    c. Accepted equivalent.

2.4 GROUT MATERIALS

A. Premixed, nonmetallic, noncorrosive, non-staining grout product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C 1107, Grade B, with fluid consistency and a 30-minute working time.

B. Non-reactive with prestressing strand, anchorage materials, or concrete and without chlorides or other chemicals known to be deleterious to prestressing strand.

C. Subject to compliance with requirements, provide one of the following:

1. Sure Grip Grout, Dayton Superior.
2. Euco N.S., Euclid Chemical Co.
3. Masterflow 928, Master Builders, Inc.

PART 3 - EXECUTION

3.1 FORMWORK

A. Provide formwork for post-tensioned elements as specified in Division 03 Section, "Cast-in-Place Concrete." Design formwork to support load redistribution that may occur during stressing operation. Ensure that formwork does not restrain elastic shortening, camber or deflection resulting from application of prestressing force.

B. Do not remove forms supporting post-tensioned elements until tendons have been fully stressed and elongations have been approved by Engineer/Architect.

3.2 TENDON INSTALLATION

A. Tendon Supports:

1. Support slab tendons independently of beam reinforcement.
2. Position supports at high and low points and at intervals not exceeding 48 inches.
3. Support tendons as required to provide the specified profile and prevent displacement during subsequent construction operations.

B. Tendon Profile:

1. Place tendons with a parabolic profile in a vertical plane conforming to control points shown on Drawings unless otherwise noted. Control points locate the center of gravity of tendons.
2. Locate low point at mid-span unless otherwise noted.
3. Maintain tendon profile with the maximum allowable deviation for corresponding member dimensions as follows:

    a. 8 inches or less: ± 0.25 inches.

    b. 8 to 24 inches: ± 0.375 inches.

    c. 24 inches or more: ± 0.5 inches.

    C. Tendon Location:

        1. Obtain Engineer/Architect's approval before relocating tendons that interfere with one another.
        2. Slight deviations in horizontal spacing and location are permitted when required to avoid openings and inserts.
        3. Maintain minimum radius of curvature of 21 feet for horizontal deviations.
        4. Locate tendons parallel to grid lines unless otherwise noted.
        5. Straighten strands to produce equal stress in all tendons that are to be stressed in a concrete placement and to ensure proper positioning of anchors.

D. Anchors:

1. Install anchors perpendicular to tendon axis.
2. Install tendons straight, without vertical or horizontal curvature, for a minimum of 12 inches behind stressing-end and intermediate anchors.
3. Attach stressing-end anchors securely to bulkhead forms to prevent loosening due to construction activity or during concrete placement.

E. Tendon Bundling:

1. Limit slab tendon bundles to two tendons.
2. Do not twist or entwine tendons within a bundle.
3. Maintain a minimum of 12 inches between centers of adjacent bundles.

F. Tendon Protection:

1. Protect tendons from moisture and corrosion prior to concrete placement.
2. Protect exposed tendons from moisture and corrosion at all times.
3. Bare tendons are not permitted at any time.
4. Do not cut or remove sheathing before concrete is placed.

G. Over occupied/finished areas permanently mark tendon locations on slab soffit.

H. Do not use splices or coupler assemblies within a concrete pour unless accepted in writing by the Engineer. When coupler assemblies are used, completely fill enclosure with corrosion inhibiting coating.

I. Welding is prohibited unless shown on the drawings or accepted in writing by the Engineer.

3.3 SHEATHING INSPECTION AND REPAIR

A. Inspect sheathing for damage after installing tendons and before placing concrete.

B. Remove and replace tendons that have damaged encapsulation systems including sheathing tears or cuts over 10 percent of the length (damage need not be continuous), sheathing withdrawn from connecting sleeves, or connecting sleeves withdrawn from fixed end anchorages.

C. Repair damaged areas by restoring corrosion inhibiting coating and repairing sheathing according to the following procedure to the satisfaction of the Engineer/Architect.

1. Coat with corrosion inhibiting coating outside of sheathing for the length of damaged area plus 2 inches beyond each end of damage. For example, if sheathing tear is 6 inches long then corrosion inhibiting coated area will be 10 inches long, centered on tear.
2. Install longitudinally slit sheathing around corrosion inhibiting coating area with the slit on the side opposite the tear. Extend slit sheathing 2 inches beyond corrosion inhibiting coating area at each end. For example, if corrosion inhibiting coating area is 10 inches long, then the slit sheathing will be 14 inches long, centered on tear.
3. After removing corrosion inhibiting coating from the area to be taped, spirally wrap tape around slit sheathing to provide at least 2 layers of tape. Extend tape 2 inches beyond slit sheathing at each end. For example, if slit sheathing is 14 inches long, then taped area will be 18 inches long, centered on tear.

D. Repair nick and cuts less than 0.25 inches long with sheathing repair material.

3.4 TENDON STRESSING

A. Calibrate stressing jacks and gages at least every 6 months and keep copies of certificates on site and available for inspection.

B. Use stressing jacks that are equipped with pressure gages to permit stress in the tendon to be computed at any time.

C. Begin stressing operations as soon as concrete strength reaches 3,000 psi.

D. Complete stressing within 96 hours after concrete placement begins unless concrete has not reached the required strength. If concrete strength has not reached minimum stressing strength within 96 hours (including weekends and holidays) apply 50 percent stress to each tendon and full stress as soon as compressive strength reaches the minimum stressing strength.

E. If measured elongation deviates from calculated elongation by more than 7 percent, recalculate elongations based on actual modulus of elasticity of strand.

F. If, after modulus check, measured and calculated elongations still deviate by more than 7 percent, cease stressing operations. Review section 7.3 from PTI's "Field Procedures Manual for Unbonded Single Strand Tendons" for causes for improper elongation. Proceed with stressing only after deviation cause has been determined and corrected to satisfaction of Engineer/Architect.

G. Do not allow tendon movement greater than 0.25 inches during wedge seating.

3.5 TENDON FINISHING

A. Do not cut tendons or cover anchorages until stressing records reviewed and accepted by Engineer/Architect.

B. Clean tendons, anchorages and pockets of corrosion inhibiting prior to cutting tendons.

C. Cut tendon end between 0.5 inches and 0.75 inches from wedges. Leave tendon end clean and free of burrs. Use of oxyacetylene flame to cut tendon is not permitted unless accepted in writing by Engineer before cutting begins. Use one of the following methods:

1. Plasma cutting.
2. Hydraulic shears.

D. Make tendon ends accessible for inspection prior to and during cutting and grouting.

E. Do not damage tendon, anchorage or concrete during the cutting and removal of the tendon.

F. For encapsulated systems, cut tendon and install watertight cap with grease no more than 8 hours after acceptance of stressing records.

G. Install a watertight assembly no more than 24 hours after stressing operations at the exposed stressing length of the intermediate anchorages.

H. Coat pocket surface with bonding agent after sealing tendon end and wedges and before grouting tendon pocket.

I. Grout tendon pockets no more than 24 hours after acceptance of stressing records. Finish grout flush with adjacent concrete.

3.6 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency approved by Engineer/Architect to perform materials testing . Inspections of stressing operations will be by the Special Inspector. Testing agency and Threshold Inspector have authority to reject work not conforming to the Contract Documents. Testing Agency shall coordinate efforts with Threshold Inspector.

B. Before concrete placement, testing agency will inspect the following for compliance with the Contract Documents and accepted Installation Drawings.

1. Location and number of tendons.
2. Tendon size and grade.
3. Tendon profile and cover.
4. Sheathing type, thickness, damage and repair.
5. Corrosion inhibiting coating.
6. Anchorages, sleeves and accessories.
7. Support methods.
8. Encapsulation system.
9. Requirements of “Florida Building Code,” Section 109.

C. During stressing operations testing agency will record the following and promptly submit to Engineer/Architect upon completion of stressing operations each day.

1. Calculated tendon elongation based on actual modulus of elasticity and cross-sectional area of tendons used.
2. Actual elongation measured for each tendon.
3. Gage pressure required to achieve required stressing force (per calibration chart) for each tendon.
4. Actual gage pressure for each tendon.
5. Required concrete strength at time of stressing.
6. Reported concrete strength at time of stressing.
7. Range of allowable elongations for stressing force.
8. Jack and gage identification numbers.
9. Installer certification that stressing process and records have been reviewed and that forces specified have been provided.

D. After stressing operations testing agency will inspect the following for compliance with the Contract Documents.

1. Tendon cutting.
2. Tendon end length.
3. Anchor caps with grease.
4. Cleaning and grouting of pockets.

E. Testing agency will prepare test and inspections reports in an accepted format. In addition to test and inspection data, include the following.

1. Project name and location.
2. Date and time of inspection.
3. Inspection location within the structure.

4. Air temperatures, weather and wind speed.
5. Testing agency's name, address and phone number.
6. Testing agency's technician's name.
7. Installer's name.

3.7 REPAIRS

A. Submit repair procedures to Engineer/Architect for acceptance prior to starting repairs.

B. Complete all required repairs at no cost to Owner.

END OF SECTION

POST-TENSIONING SUPPLIER QUALIFICATION FORM

GENERAL INFORMATION:	
Project:	City:
Supplier:	
General Contractor:	

SAMPLE PROJECT #1	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

SAMPLE PROJECT #2	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

POST-TENSIONING SUPPLIER QUALIFICATION FORM

SAMPLE PROJECT #3	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

SAMPLE PROJECT #4	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

POST-TENSIONING SUPPLIER QUALIFICATION FORM

SAMPLE PROJECT #5	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

REQUIRED ATTACHMENTS	
	Quality plan for manufacture, delivery, and detailing of post-tensioning system.
	Verification letter stating that the post-tensioning system will be manufactured in a plant with a current PTI certification and that all materials conform with ACI 301, ACI 318, and are approved by the International Code Council (International Building Code.)

POST-TENSIONING INSTALLER QUALIFICATION FORM

GENERAL INFORMATION:	
Project:	City:
Installer:	
General Contractor:	

SAMPLE PROJECT #1	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

SAMPLE PROJECT #2	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

POST-TENSIONING INSTALLER QUALIFICATION FORM

SAMPLE PROJECT #3	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

SAMPLE PROJECT #4	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

POST-TENSIONING INSTALLER QUALIFICATION FORM

SAMPLE PROJECT #5	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

REQUIRED ATTACHMENTS	
	Resume of Project Superintendent indicating required experience.
	Letter from post-tensioning Supplier accepting Installer.
	Verification letter stating that the Installer has a current PTI certification and that PTI Certified Field Installers will be used to install and stress post-tensioning system.

SECTION 03 3801 - POST-TENSIONED CONCRETE - PARKING GARAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. In accordance with Contract Documents, provide all materials, labor, equipment, and supervision to fabricate and install all post-tensioning Work. Non-prestressed reinforcement shall conform to Division 03 Section, "Cast-in-Place Concrete."

B. Meet the requirements of ACI 301, ACI 318, ACI 423.7, CRSI MSP-2, and Contract Documents. In case of a conflict, meet the more stringent requirement.

C. Related work in other Sections related to Post-Tensioned Concrete:

1. Division 01 Section “Project Management and Coordination.”
2. Division 03 Section "Cast-in-Place Concrete (Parking Garage)."

1.3 REFERENCES

A. Field Reference: Keep a copy of the following reference in the Contractor’s field office.

1. PTI’s “Field Procedures Manual for Unbonded Single Strand Tendons”

B. American Concrete Institute (ACI):

1. ACI 301, “Specification for Structural Concrete.”
2. ACI 318, "Building Code Requirements for Structural Concrete."
3. ACI 347, "Recommended Practice for Concrete Formwork."
4. ACI 362.1R-12, “Guide for the Design of Durable Parking Structures.”
5. ACI 423.3R, "Recommendations for Concrete Members Prestressed with Unbonded Tendons."
6. ACI 423.7, “Specification for Unbonded Single-Strand Tendon Materials and Commentary.”

C. American Society for Testing and Materials (ASTM):

1. ASTM A416, "Specification for Uncoated Seven-Wire Strand for Prestressed Concrete."
2. ASTM E328, "Recommended Practice for Stress-Relaxation Tests for Materials and Structures."

D. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI MSP-2, "Manual of Standard Practice."

E. Post-Tensioning Institute (PTI):

1. PTI, "Guide Specifications for Post-Tensioning Materials."
2. PTI, "Performance Specification for Corrosion Preventive Coating."
3. PTI, "Specification for Unbonded Single Strand Tendons."

4. PTI, "Field Procedures Manual for Unbonded Single Strand Tendons."

F. Florida Building Commission:

1. FBC, "Florida Building Code."

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the tendon and anchor locations with Work of other Sections, including “Cast-in-Place Concrete.” Immediately inform Engineer/Architect of any potential interference.

B. Sequencing:

1. Deviations in the construction and stressing sequence shown on the Drawings are not permitted without written acceptance from Engineer/Architect.

C. Make submittals in accordance with requirements of Division 01 Section, “Submittal Procedures:”

1. See requirements of Division 01 Section, “Submittal Procedures,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.
2. See requirements of Division 01 Section, “Submittal Procedures,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.5 ACTION SUBMITTALS

A. Product Data: For each product as indicated.

1. Corrosion Inhibiting Coating: Type and chemical analysis.
2. Sheathing: Type, material, density and thickness.
3. Anchorage Device: Type, material and size.
4. Coupler Device: Type, material and size.
5. Pocket Former: Type, material and size.
6. Sheathing Repair Tape: Type, material and width.
7. Encapsulation System: Type and materials.

B. Shop Drawings: Include the following prepared by or under the supervision of a qualified professional engineer:

1. Number, arrangement and designation of tendons.
2. Tendon profile and method of tendon support. Show tendon profiles at sufficient scale to clearly indicate tendon high and low points.
3. Tendon anchorage details including bundled tendon flaring.

C. Construction Manager is expected to employ qualified personnel to review submittals before they are submitted to Engineer for review.

D. Resubmittals: Engineer will review each of Contractor’s submittals the initial time and, should resubmittal be required, again to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions.

1. Make resubmittals in same form and number of copies as initial submittal.
   a. Note date and content of previous submittal.
   b. Note date and content of revision in label or title block and clearly indicate extent of revision.

E. Resubmit submittals until they are marked with approval notation from Engineer's and Construction Manager's action stamp

F. Samples: For the following products:

1. Each anchorage assembly with a minimum of 24 inches of coated, sheathed strand.
2. Each coupler assembly with a minimum of 24 inches of coated, sheathed strand.
3. Encapsulation system.

G. Delegated-Design: For post-tensioning system.

1. Signed and sealed calculations prepared by a qualified structural engineer in the State of Florida indicating method of elongation and determination of number of tendons. Include values used for friction coefficients, anchorage seating loss, elastic shortening, creep, relaxation, wobble and shrinkage.

H. Stressing Records: Same day as stressing operation.

I. Sustainable Design Documentation Submittals: Refer to section 01 8113.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Leadership Extraction Practices for Recycled Content for records

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Supplier and Installer at least 14 days prior to bid date using the forms at the end of this section.

B. Mill Test Reports: Certified mill test reports for each coil or pack of strand used on Project, indicating that strand is low relaxation and including the following information:

1. Heat number and identification.
2. Minimum breaking strength.
3. Yield strength at 1 percent extension under load.
4. Elongation at failure.
5. Modulus of elasticity.
6. Diameter and net area of strand.

C. Test and Evaluation Reports: Indicating compliance with the following requirements:

1. Tests required by ACI 301, Section “Post-Tensioned Concrete.”
2. Hydrostatic tests required by ACI 423.7 for “Anchorages and couplers in aggressive environments.”

3. Relaxation loss tests required by ACI 423.7 for low relaxation prestressing steel.

D. Field Quality-Control Reports: Within 72 hours of inspection.

E. Stressing Jack Calibration: Calibration certificates for jacks and gages to be used on Project. Calibrate each jack-and-gage set as a pair.

F. Warranty: Proposed warranty prior to the start of construction.

1.7 QUALITY ASSURANCE

A. Supplier Qualifications:

1. Use a fabricating plant certified by PTI.
2. Successfully provided all materials for at least 5 post-tensioning installations in parking structures in the United States with a structural system similar to Project within the previous 5 years. Provide all information requested on the form at the end of this section.

B. Installer Qualifications:

1. Certified by PTI.
2. Successfully performed at least 5 post-tensioning installations in parking structures in the United States with a structural system similar to Project within the previous 5 years. Provide all information requested on the form at the end of this section.
3. Use a full-time Project superintendent that has supervised at least 5 projects of similar magnitude.
4. Use PTI Certified Field Installers to install and stress post-tensioning system.

C. Suppliers, who do not meet the qualification requirements above, shall meet and pay for following requirements:

1. Retain independent testing or consulting firm acceptable to Engineer/Architect.
2. Acceptable firm shall inspect post-tensioning Supplier's plant at 1 wk intervals during production and issue report on each visit, signed and sealed by Florida Licensed Professional Engineer verifying that materials, methods, product, and quality meet all PTI Plant Certification and Project specification requirements. Sample tendon corrosion preventive coating being applied during each visit and send sample directly to Engineer/Architect-designated testing laboratory for testing.
3. If firm's report indicates noncompliance, Engineer/Architect, at Owner's expense, may inspect and may reject any or all products produced during period of noncompliance.

D. Comply with requirements in ACI 301, Section "Post-Tensioned Concrete."

E. Perform all post-tensioning Work under the supervision of a Project Superintendent who is present during all operations including installation, concrete placement, stressing and finishing.

1.8 DELIVERY, STORAGE AND HANDLING

A. Assign all tendons in same member the same heat number and identify accordingly.

B. Package each tendon bundle at source to prevent physical damage to tendon during transportation and storage, and to protect strand from moisture. Use heavy padding cardboard is not permitted. Do not use wire binding or other materials that could cut the sheathing or tendon.

C. Deliver, store and handle post-tensioning materials according to ACI 423.7. Contractor to inspect tendons and accessory items at time of delivery to Project site, prior to off-loading. Notify post-tensioning supplier of observed damage prior to off-loading.

D. Immediately remove damaged components from Project site and replace at no cost to Owner.

E. Do not remove sheathing on stressing end until the day of stressing.

F. Materials Stored on Slabs:

1. Prior to final stressing of beams and slabs, do not store any materials on slab.
2. After final stressing of beams and slabs but before concrete has reached the specified 28-day strength, do not store materials on slab such that the weight exceeds 50 percent of the design live load.
3. After final stressing of beams and slabs and concrete has reached the specified 28-day strength, do not store materials on slab such that the weight exceeds the design live load.

1.9 WARRANTY

A. Provide a warranty from the Supplier that includes the following terms and provisions.

1. Warranty period of 5 years beginning with the date of Beneficial Occupancy.
2. Correct, at no expense to Owner, any defects that develop during the warranty period, which can be attributed to a defect in quality of product or workmanship.
3. All materials have been manufactured in accordance with the Project specifications.
4. Installation of materials, if under the control of the Supplier, has been according to the Project specifications.
5. Supplier is not responsible for damage or liability caused by the actions or omissions of others.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. System described in this Section intended to satisfactorily perform in ACI 362.1R-12 zone CC-II environment without long-term corrosion or other distress.

B. Engage a qualified professional engineer licensed in Florida to provide tendon quantity calculations and detail the tendon layout based on the following:

1. Provide the final effective forces indicated on the drawings, which are the stressing forces minus both the short- and long-term losses.
2. Do not exceed the maximum tensile stress in the tendon during the stressing operation. The maximum tensile stress is the smallest of the following:

a. 80 percent of the specified tensile strength of the tendon.

b. 94 percent of the specified yield strength of the tendon.

c. Maximum value recommended by the tendon manufacturer.

3. Do not exceed 70 percent of the specified tensile strength after the anchors are seated.
4. Use PTI recommended values for friction and wobble coefficients unless test data is submitted to substantiate lower values.
5. Limit main slab tendon maximum spacing according to ACI 318, chapter “Prestressed Concrete,” heading “Slab Systems.”
6. For multi-span tendons, do not base the effective tendon force on the average stress for all spans. Calculate losses for each span independently.

2.2 PRESTRESSING TENDONS

A. Prestressing Strand: ASTM A416, Grade 270, uncoated, seven-wire, low-relaxation strand with minimum ultimate strength of 270 ksi.

1. Manufactured by a single source.
2. Strands manufactured outside United States subject to Engineer/Architect’s approval based on evidence of satisfactory performance in the United States during the previous 5 years.
3. Use of high stress bar system instead of strand system is not permitted unless accepted in writing by the Engineer.
4. Conform to ACI 423.7 for relaxation loss requirements.
5. There shall be 0% recycled steel for the strands

B. Tendon Sheathing: Seamless and extruded high density polypropylene or seamless and extruded high density polyethylene with a specific gravity greater than 0.95 conforming to ACI 423.7.

1. Sufficient strength to withstand damage during fabrication, transport, installation, concrete placement and stressing.
2. Minimum thickness of 50 mils (–0 mils +15 mils)
3. Minimum inside diameter 0.03 inches greater than maximum strand diameter.
4. Chemically stable without becoming brittle or softening over anticipated temperature range and service life of structure.
5. Non-reactive with concrete, steel and corrosion inhibiting coating.
6. Contrasting color of corrosion inhibiting coating to enhance visibility of damage. Black/dark colored sheathing is not acceptable.
7. Annular space between sheathing and strand completely filled with corrosion inhibiting coating.
8. Watertight including all connections and components over entire length.

C. Tendon Anchor: Non-porous casting free of sand, blow holes, voids and other defects meeting the testing and material requirements of ACI 423.7.

1. Plastic coated bearing plates sized in accordance with ACI 423.7, unless certified test reports substantiate comparable or superior performance, for transfer at minimum stressing concrete strength.
2. Capable of complying with PTI Guide Specification requirements for aggressive environments.

3. Capable of developing at least 95% of the actual ultimate strength of tendon.
4. Minimum wedge cavity opening of at least 0.19 inches larger than tendon diameter. Reaming of anchor wedge cavity is not permitted.
5. Wedges capable of precluding failure of tendon due to notching or pinching effects during static and fatigue load tests stipulated in ACI 423.7.
6. Provisions for a plastic cap which fits tightly and seals barrel end on stressing side of anchor.
7. Provisions for a plastic sleeve which prevents moisture infiltration into anchor casting or tendon sheathing on bearing side of anchor.

D. Coupler Assembly: Assembly of strands and wedges meeting the testing and material requirements of ACI 301.

1. Capable of complying with PTI Guide Specification requirements for aggressive environments.
2. Capable of developing at least 95 percent of the ultimate strength of tendon.
3. Wedges capable of precluding failure of tendon due to notching or pinching effects during static and fatigue load tests stipulated in ACI 423.7.

E. Encapsulation System: Watertight encapsulation along the entire length of tendon, including anchorages and couplers, when subjected to hydrostatic testing required in ACI 423.7 for aggressive environments.

1. Sleeve: Translucent plastic with a positive mechanical connection to anchorages capable of resisting 100 lbs. pulling force. Minimum 10 inches long and 4 inches overlap with sheathing, completely filled with corrosion inhibiting coating.
2. Anchor Cap: Translucent plastic with a positive mechanical connection to anchorages capable of resisting 100 lbs. pulling force. At intermediate anchorages, open to allow passage of strand.
3. Subject to the requirements provide one of the following systems:

   a. “Zero Void,” General Technologies, Inc.

   b. “Hayes Posi-Lock Plus,” Hayes Industries, Ltd.

   c. Accepted equivalent.

2.3 ACCESSORIES

A. Pocket Formers: Capable of completely sealing wedge cavity from intrusion of concrete or cement slurry; sized to provide at least a 2 inch recess and allow access for cutting strand tail.

1. If Zero Void encapsulation system in used, the “Zero Void Nail-Less Pocket Former” is required.

B. Anchorage Fasteners: Stainless-steel ring nails. Subject to the requirements use one of the following:

1. Clendenin Brothers, Baltimore, MD.
2. Swan Secure Products, Baltimore, MD.
3. R.J. Leahy Co., San Francisco, CA.
4. Accepted equivalent.

C. Sheathing Repair Tape: Elastic, self-adhesive, moisture-proof tape with a minimum width of 2 inches in contrasting color to tendon sheathing, and that is non-reactive with sheathing, corrosion inhibiting coating, or tendon. Subject to the requirements use one of the following:

1. “3M Tape No. 226,” 3M, St. Paul, MN.
2. “Polyken 826,” Berry Plastics Corp, Evansville, IN
3. “Tyco Adhesives No. 398,” Tyco Adhesives, Franklin, MA

D. Sheathing Repair Material: For nicks and cuts less than 0.25 inches use one of the following:

1. “Scotch-Weld DP-8005,” by 3M.
2. Accepted equivalent.

E. Corrosion inhibiting coating: Capable of meeting the requirements of ACI 423.7. Subject to the requirements use one of the following

1. "Greasrex K-218," ExxonMobil Oil Corp., Irving, TX.
2. “Red-i PT Coating Grease,” Lubricating Specialties Co., Pico Rivera, CA
3. “Renolit PTG,” Fuch’s Lubricant Co., Harvey, IL
4. “Royal PT-1 and PT-2 Corrosion Inhibiting Grease,” Troco Oil Co., Tulsa, OK

F. Tendon supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening tendons in place. Use tendon supports capable of meeting the requirements in CRSI’s “Manual of Standard Practice” and as follows:

1. Clearly marked to differentiate by height.
2. Capable of resisting overturning during construction operations.
3. Minimal contact with forms where concrete is exposed to view.
4. Do not cause voids or damage to surrounding concrete.
5. All-plastic supports conforming to CRSI Class 1 protection requirements and with a compressive strength higher than concrete.
6. Acceptable manufacturers:

    a. Aztec Concrete Accessories, Inc.
    b. General Technologies, Inc.
    c. Accepted equivalent.

2.4 GROUT MATERIALS

A. Premixed, nonmetallic, noncorrosive, non-staining grout product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C 1107, Grade B, with fluid consistency and a 30-minute working time.

B. Non-reactive with prestressing strand, anchorage materials, or concrete and without chlorides or other chemicals known to be deleterious to prestressing strand.

C. Subject to compliance with requirements, provide one of the following:

1. Sure Grip Grout, Dayton Superior.
2. Euco N.S., Euclid Chemical Co.
3. Masterflow 928, Master Builders, Inc.

PART 3 - EXECUTION

3.1 FORMWORK

A. Provide formwork for post-tensioned elements as specified in Division 03 Section, “Cast-in-Place Concrete.” Design formwork to support load redistribution that may occur during stressing operation. Ensure that formwork does not restrain elastic shortening, camber or deflection resulting from application of prestressing force.

B. Do not remove forms supporting post-tensioned elements until tendons have been fully stressed and elongations have been approved by Engineer/Architect.

3.2 TENDON INSTALLATION

A. Tendon Supports:

1. Support slab tendons independently of beam reinforcement.
2. Position supports at high and low points and at intervals not exceeding 48 inches.
3. Support tendons as required to provide the specified profile and prevent displacement during subsequent construction operations.

B. Tendon Profile:

1. Place tendons with a parabolic profile in a vertical plane conforming to control points shown on Drawings unless otherwise noted. Control points locate the center of gravity of tendons.
2. Locate low point at mid-span unless otherwise noted.
3. Maintain tendon profile with the maximum allowable deviation for corresponding member dimensions as follows:

a. 8 inches or less: ± 0.25 inches.

b. 8 to 24 inches: ± 0.375 inches.

c. 24 inches or more: ± 0.5 inches.

C. Tendon Location:

1. Obtain Engineer/Architect’s approval before relocating tendons that interfere with one another.
2. Slight deviations in horizontal spacing and location are permitted when required to avoid openings and inserts.
3. Maintain minimum radius of curvature of 21 feet for horizontal deviations.
4. Locate tendons parallel to grid lines unless otherwise noted.
5. Straighten strands to produce equal stress in all tendons that are to be stressed in a concrete placement and to ensure proper positioning of anchors.

D. Anchors:

1. Install anchors perpendicular to tendon axis.
2. Install tendons straight, without vertical or horizontal curvature, for a minimum of 12 inches behind stressing-end and intermediate anchors.

3. Attach stressing-end anchors securely to bulkhead forms to prevent loosening due to construction activity or during concrete placement.

E. Tendon Bundling:

1. Limit slab tendon bundles to two tendons.
2. Do not twist or entwine tendons within a bundle.
3. Maintain a minimum of 12 inches between centers of adjacent bundles.

F. Tendon Protection:

1. Protect tendons from moisture and corrosion prior to concrete placement.
2. Protect exposed tendons from moisture and corrosion at all times.
3. Bare tendons are not permitted at any time.
4. Do not cut or remove sheathing before concrete is placed.

G. Over occupied/finished areas permanently mark tendon locations on slab soffit.

H. Do not use splices or coupler assemblies within a concrete pour unless accepted in writing by the Engineer. When coupler assemblies are used, completely fill enclosure with corrosion inhibiting coating.

I. Welding is prohibited unless shown on the drawings or accepted in writing by the Engineer.

3.3 SHEATHING INSPECTION AND REPAIR

A. Inspect sheathing for damage after installing tendons and before placing concrete.

B. Remove and replace tendons that have damaged encapsulation systems including sheathing tears or cuts over 10 percent of the length (damage need not be continuous), sheathing withdrawn from connecting sleeves, or connecting sleeves withdrawn from fixed end anchorages.

C. Repair damaged areas by restoring corrosion inhibiting coating and repairing sheathing according to the following procedure to the satisfaction of the Engineer/Architect.

1. Coat with corrosion inhibiting coating outside of sheathing for the length of damaged area plus 2 inches beyond each end of damage. For example, if sheathing tear is 6 inches long then corrosion inhibiting coated area will be 10 inches long, centered on tear.
2. Install longitudinally slit sheathing around corrosion inhibiting coating area with the slit on the side opposite the tear. Extend slit sheathing 2 inches beyond corrosion inhibiting coating area at each end. For example, if corrosion inhibiting coating area is 10 inches long, then the slit sheathing will be 14 inches long, centered on tear.
3. After removing corrosion inhibiting coating from the area to be taped, spirally wrap tape around slit sheathing to provide at least 2 layers of tape. Extend tape 2 inches beyond slit sheathing at each end. For example, if slit sheathing is 14 inches long, then taped area will be 18 inches long, centered on tear.

D. Repair nick and cuts less than 0.25 inches long with sheathing repair material.

3.4 TENDON STRESSING

A. Calibrate stressing jacks and gages at least every 6 months and keep copies of certificates on site and available for inspection.

B. Use stressing jacks that are equipped with pressure gages to permit stress in the tendon to be computed at any time.

C. Begin stressing operations as soon as concrete strength reaches 3,000 psi.

D. Complete stressing within 96 hours after concrete placement begins unless concrete has not reached the required strength. If concrete strength has not reached minimum stressing strength within 96 hours (including weekends and holidays) apply 50 percent stress to each tendon and full stress as soon as compressive strength reaches the minimum stressing strength.

E. If measured elongation deviates from calculated elongation by more than 7 percent, recalculate elongations based on actual modulus of elasticity of strand.

F. If, after modulus check, measured and calculated elongations still deviate by more than 7 percent, cease stressing operations. Review section 7.3 from PTI's "Field Procedures Manual for Unbonded Single Strand Tendons" for causes for improper elongation. Proceed with stressing only after deviation cause has been determined and corrected to satisfaction of Engineer/Architect.

G. Do not allow tendon movement greater than 0.25 inches during wedge seating.

3.5 TENDON FINISHING

A. Do not cut tendons or cover anchorages until stressing records reviewed and accepted by Engineer/Architect.

B. Clean tendons, anchorages and pockets of corrosion inhibiting prior to cutting tendons.

C. Cut tendon end between 0.5 inches and 0.75 inches from wedges. Leave tendon end clean and free of burrs. Use of oxyacetylene flame to cut tendon is not permitted unless accepted in writing by Engineer before cutting begins. Use one of the following methods:

1. Plasma cutting.
2. Hydraulic shears.

D. Make tendon ends accessible for inspection prior to and during cutting and grouting.

E. Do not damage tendon, anchorage or concrete during the cutting and removal of the tendon.

F. For encapsulated systems, cut tendon and install watertight cap with grease no more than 8 hours after acceptance of stressing records.

G. Install a watertight assembly no more than 24 hours after stressing operations at the exposed stressing length of the intermediate anchorages.

H. Coat pocket surface with bonding agent after sealing tendon end and wedges and before grouting tendon pocket.

I. Grout tendon pockets no more than 24 hours after acceptance of stressing records. Finish grout flush with adjacent concrete.

3.6 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency approved by Engineer/Architect to perform materials testing . Inspections of stressing operations will be by the Special Inspector. Testing agency and Threshold Inspector have authority to reject work not conforming to the Contract Documents. Testing Agency shall coordinate efforts with Threshold Inspector.

B. Before concrete placement, testing agency will inspect the following for compliance with the Contract Documents and accepted Installation Drawings.

1. Location and number of tendons.
2. Tendon size and grade.
3. Tendon profile and cover.
4. Sheathing type, thickness, damage and repair.
5. Corrosion inhibiting coating.
6. Anchorages, sleeves and accessories.
7. Support methods.
8. Encapsulation system.
9. Requirements of “Florida Building Code,” Section 109.

C. During stressing operations testing agency will record the following and promptly submit to Engineer/Architect upon completion of stressing operations each day.

1. Calculated tendon elongation based on actual modulus of elasticity and cross-sectional area of tendons used.
2. Actual elongation measured for each tendon.
3. Gage pressure required to achieve required stressing force (per calibration chart) for each tendon.
4. Actual gage pressure for each tendon.
5. Required concrete strength at time of stressing.
6. Reported concrete strength at time of stressing.
7. Range of allowable elongations for stressing force.
8. Jack and gage identification numbers.
9. Installer certification that stressing process and records have been reviewed and that forces specified have been provided.

D. After stressing operations testing agency will inspect the following for compliance with the Contract Documents.

1. Tendon cutting.
2. Tendon end length.
3. Anchor caps with grease.
4. Cleaning and grouting of pockets.

E. Testing agency will prepare test and inspections reports in an accepted format. In addition to test and inspection data, include the following.

1. Project name and location.
2. Date and time of inspection.
3. Inspection location within the structure.
4. Air temperatures, weather and wind speed.
5. Testing agency’s name, address and phone number.
6. Testing agency’s technician’s name.
7. Installer’s name.

3.7 REPAIRS

A. Submit repair procedures to Engineer/Architect for acceptance prior to starting repairs.

B. Complete all required repairs at no cost to Owner.

END OF SECTION

POST-TENSIONING SUPPLIER QUALIFICATION FORM

GENERAL INFORMATION:	
Project:	City:
Supplier:	
General Contractor:	

SAMPLE PROJECT #1	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
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Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

POST-TENSIONING SUPPLIER QUALIFICATION FORM

SAMPLE PROJECT #5	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

REQUIRED ATTACHMENTS	
	Quality plan for manufacture, delivery, and detailing of post-tensioning system.
	Verification letter stating that the post-tensioning system will be manufactured in a plant with a current PTI certification and that all materials conform with ACI 301, ACI 318, and are approved by the International Code Council (International Building Code.)

POST-TENSIONING INSTALLER QUALIFICATION FORM

GENERAL INFORMATION:	
Project:	City:
Installer:	
General Contractor:	

SAMPLE PROJECT #1	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

SAMPLE PROJECT #2	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

POST-TENSIONING INSTALLER QUALIFICATION FORM

SAMPLE PROJECT #3	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

SAMPLE PROJECT #4	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

POST-TENSIONING INSTALLER QUALIFICATION FORM

SAMPLE PROJECT #5	Date Completed:
Project Name:	$ Value of PT Sub-contract:
City and State:	Tonnage of PT tendons:
Engineer of Record	General Contractor
Name:	Project Manager:
Firm:	Firm:
Phone Number:	Phone Number:
Email:	Email:

REQUIRED ATTACHMENTS	
	Resume of Project Superintendent indicating required experience.
	Letter from post-tensioning Supplier accepting Installer.
	Verification letter stating that the Installer has a current PTI certification and that PTI Certified Field Installers will be used to install and stress post-tensioning system.

SECTION 03 45 00 - PRECAST ARCHITECTURAL CONCRETE

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Architectural precast concrete cladding units.

B. Related Requirements:

1. Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
2. Section 03 30 00 "Cast-in-Place Concrete" for installing connection anchors in concrete.
3. Section 05 12 00 "Structural Steel Framing" for furnishing and installing connections attached to structural-steel framing.
4. Section 05 50 00 "Metal Fabrications" for kickers and other miscellaneous steel shapes.
5. Section 07 19 00 "Water Repellents" for water-repellent finish treatments.

1.3 DEFINITIONS

A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Regional/Local Multiplier Compliance
   b. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Corporate Sustainability Reporting (CSR’s)

C. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

D. Shop Drawings:

1. Detail fabrication and installation of architectural precast concrete units.
2. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit.
3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
4. Indicate details at building corners.
5. Retain subparagraphs below applicable to Project.
6. Indicate separate face and backup mixture locations and thicknesses.
7. Indicate type, size, and length of welded connections by AWS standard symbols. Detail loose and cast-in hardware and connections.
8. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
9. Indicate locations, extent, and treatment of dry joints if two-stage casting is proposed.
10. Include plans and elevations showing unit location and sequence of erection for special conditions.
11. Indicate location of each architectural precast concrete unit by same identification mark placed on panel.
12. Indicate relationship of architectural precast concrete units to adjacent materials.
13. Indicate locations, dimensions, and details of thin-brick units, including corner units and special shapes, and joint treatment.
14. Indicate locations, dimensions, and details of stone facings, anchors, and joint widths.
15. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.

E. Samples: Design reference samples for initial verification of design intent, for each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, representative of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.

1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.

F. Delegated-Design Submittal: For architectural precast concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Show governing panel types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Statements:

1. Fabricator:
   a. Submit plant certification.
   b. Submit evidence of experience and capabilities.
   c. Submit copies of plant quality control program.
2. Erector: Submit evidence of experience and capabilities.
3. Welding: Submit welding certificates and field welding processes.

B. Material Certificates: For the following items:

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Structural-steel shapes and hollow structural sections.

C. Material Test Reports: For aggregates.

D. Preconstruction test reports.

E. Source quality-control test reports.

F. Field quality-control and special inspection reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance to erect Category A (Architectural Systems) for non-load-bearing members.

B. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

1. Designated as a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units at time of bidding or designated as an APA-certified plant for production of architectural precast concrete products.

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

D. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

F. Mockups: After sample panel and range sample approval but before production of architectural precast concrete units, construct full-sized mockups to verify selections

made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution. Refer to Section 01 43 39 “Visual Mock-up Requirements” for additional requirements.

1. Build mockup as indicated on Drawings complete with anchors, connections, flashings, and joint fillers.
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. Subject to compliance with requirements, approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

1.8 COORDINATION

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground or other rehandling.

B. Support units during shipment on nonstaining shock-absorbing material.

C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

D. Place stored units so identification marks are clearly visible, and units can be inspected.

E. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.

F. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 45 00 “Quality Control”, to design architectural precast concrete units.

B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

C. Calculated Fire-Test-Response Characteristics: Provide architectural precast concrete units with fire-resistance rating indicated as calculated according to ACI 216.1 and acceptable to authorities having jurisdiction.

D. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Retain "Loads" Subparagraph below if design loads are shown on Drawings.
2. Loads: As indicated.
3. Retain five loads subparagraphs below if including design loads here; revise requirements to suit Project, and insert other performance and design criteria if applicable.
4. Dead Loads: Refer to Structural.
5. Live Loads: Refer to Structural.
6. Wind Loads: Refer to Structural.
7. Seismic Loads: Refer to Structural.
8. Project-Specific Loads: Refer to Structural.
9. Design precast concrete units and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements as follows:
   a. Upward and downward movement of 1/2 inch.
10. Revise "Thermal Movements" Subparagraph below to suit local conditions. Temperature data are available from National Climatic Data Center, www.ncdc.noaa.gov.
11. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 80 deg F.

2.2 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

B. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Use with manufacturer's recommended form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

C. Surface Retarder: Chemical set retarder, capable of temporarily delaying final hardening of newly placed concrete mixture to depth of reveal specified.

2.3 REINFORCING MATERIALS

A. Provide Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

C. Corporate Sustainability Report: Provide third-party verified Corporate Sustainability Report (CPD) including impacts of extraction operations and activities associated with the manufacturer's product and product's supply chain conforming the following:

1. Global Reporting Initiative (GRI) Sustainability report
2. Organization for Economic Co-operation and Development (OOECD) Guidelines for Multinational Enterprises.
3. U.N. Global Compact: Communication of Progress
4. ISO 26000: 2010 Guidance on Social Responsibility
5. USGBC Approved Program: Other approved programs meeting the CSR criteria.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

E. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, with ASTM A 767/A 767M, Class II zinc coating and chromate treatment.

F. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M epoxy coated.

G. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60, deformed bars, assembled with clips.

H. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from steel wire into flat sheets.

I. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

J. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, plain, flat sheet, Type 1 bendable coating.

K. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.4 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 100 miles of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Portland Cement: ASTM C 150/C 150M, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.

C. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin: ASTM C 618, Class N.
3. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.
4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
5. Blended Hydraulic Cement: ASTM C 595, [Type IS, portland blast-furnace slag] [Type IP, portland-pozzolan] [Type I (PM), pozzolan-modified portland] [Type I (SM), slag-modified portland] cement.

D. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33/C 33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
   a. Gradation: To match design reference sample.
2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate; to match approved finish sample.

E. Lightweight Aggregates: Except as modified by PCI MNL 117, ASTM C 330/C 330M, with absorption less than 11 percent.

F. Coloring Admixture: ASTM C 979/C 979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

G. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

H. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

I. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: 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. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
7. Plasticizing Admixture: ASTM C 1017/C 1017M, Type I.
8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
9. Corrosion Inhibiting Admixture: ASTM C 1582/C 1582M.

2.5 STEEL CONNECTION MATERIALS

A. Provide Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

C. Corporate Sustainability Report: Provide third-party verified Corporate Sustainability Report (CPD) including impacts of extraction operations and activities associated with the manufacturer’s product and product’s supply chain conforming the following:

1. Global Reporting Initiative (GRI) Sustainability report
2. Organization for Economic Co-operation and Development (OOECD) Guidelines for Multinational Enterprises.
3. U.N. Global Compact: Communication of Progress
4. ISO 26000: 2010 Guidance on Social Responsibility
5. USGBC Approved Program: Other approved programs meeting the CSR criteria.

D. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

E. Carbon-Steel-Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or Type B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.

F. Carbon-Steel Plate: ASTM A 283/A 283M, Grade C.

G. Malleable Iron Castings: ASTM A 47/A 47M, Grade 32510 or Grade 35028.

H. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30.

I. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.

J. Carbon-Steel Structural Tubing: ASTM A 500/A 500M, Grade B or Grade C.

K. Wrought Carbon-Steel Bars: ASTM A 675/A 675M, Grade 65.

L. Deformed-Steel Wire or Bar Anchors: ASTM A 496/A 496M or ASTM A 706/A 706M.

M. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A or ASTM F 1554, Grade 36; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563; and flat, unhardened steel washers, ASTM F 844.

N. High-Strength Bolts and Nuts: ASTM A 325, Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A 563; and hardened carbon-steel washers, ASTM F 436.

O. Zinc-Coated Finish: For exterior steel items, steel in exterior walls, and items indicated for galvanizing, apply zinc coating by hot-dip process according to ASTM A 123/A 123M or ASTM A 153/A 153M.

1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03 percent or to between 0.15 and 0.25 percent or limit sum of silicon and 2.5 times phosphorous content to 0.09 percent.
2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.

P. Shop-Primed Finish: Prepare surfaces of nongalvanized steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3 and shop-apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.

Q. Welding Electrodes: Comply with AWS standards.

2.6 BEARING PADS

A. Provide one of the following bearing pads for architectural precast concrete units as recommended by precast fabricator for application:

1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, Type A durometer hardness of 50 to 70, ASTM D 2240, minimum tensile strength 2250 psi, ASTM D 412.
2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. Type A durometer hardness of 70 to 90, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; Type A durometer hardness of 80 to 100, ASTM D 2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18 .1 0.2; or with MIL-C-882E.
4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.7 ACCESSORIES

A. Reglets: Specified in Section 07 62 00 "Sheet Metal Flashing and Trim."

B. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install architectural precast concrete units.

C. Anchors: Type and size indicated, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666.

D. Dowels: 1/2-inch-diameter round bars, fabricated from Type 304 stainless steel complying with ASTM A 240/A 240M, ASTM A 276, or ASTM A 666.

E. Weep/Vent Products: Use the following unless otherwise indicated:

1. Round Plastic Weep/Vent Tubing: Medium-density polyethylene, 3/8-inch OD by length equal to thickness of precast concrete panel.

2.8 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150/C 150M, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

2.9 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

1. Use a single design mixture for units with more than one major face or edge exposed.
2. Where only one face of unit is exposed use either a single design mixture or separate mixtures for face and backup.

B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.

C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.

E. Normal-Weight Concrete Mixtures: Proportion [face mixtures] [face and backup mixtures] [full-depth mixture] [face and backup mixtures or full-depth mixtures, at fabricator's option] by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi minimum.
2. Maximum Water-Cementitious Materials Ratio: 0.45.

F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C 642, except for boiling requirement.

G. Lightweight Concrete Backup Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.2, with materials to be used on Project, to provide lightweight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi.
2. Unit Weight: Calculated equilibrium unit weight of 115 lb/cu. ft., plus or minus 3 lb/cu. ft., according to ASTM C 567.

H. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

I. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.10 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

1. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concrete placement. Coat form liner with form-release agent.

B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces exposed to view in the finished work.
2. Edge and Corner Treatment: Uniformly chamfered.

2.11 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
3. Place reinforcing steel and prestressing strands to maintain at least 3/4-inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

G. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

H. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.

I. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

1. Place backup concrete mixture to ensure bond with face-mixture concrete.

J. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.

1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.

K. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

L. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that does not show in finished structure.

M. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

N. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.12 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

B. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with the following product tolerances:

1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:
    a. 10 feet or under, plus or minus 1/8 inch.
    b. 10 to 20 feet, plus 1/8 inch, minus 3/16 inch.
    c. 20 to 40 feet, plus or minus 1/4 inch.
    d. Each additional 10 feet, plus or minus 1/16 inch.
2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:
    a. 10 feet or under, plus or minus 1/4 inch.
    b. 10 to 20 feet, plus 1/4 inch, minus 3/8 inch.
    c. 20 to 40 feet, plus or minus 3/8 inch.
    d. Each additional 10 feet, plus or minus 1/8 inch.
3. Total Thickness or Flange Thickness: Plus 1/4 inch, minus 1/8 inch.
4. Rib Thickness: Plus or minus 1/8 inch.
5. Rib to Edge of Flange: Plus or minus 1/8 inch.
6. Distance between Ribs: Plus or minus 1/8 inch.
7. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch/72 inches or 1/2 inch total, whichever is greater.
8. Length and Width of Block-outs and Openings within One Unit: Plus or minus 1/4 inch.
9. Location and Dimension of Block-outs Hidden from View and Used for HVAC and Utility Penetrations: Plus or minus 3/4 inch.
10. Bowing: Plus or minus L/360, maximum 1 inch.
11. Local Smoothness: 1/4 inch/10 feet.

12. Warping: 1/16 inch/12 inches of distance from nearest adjacent corner.
13. Tipping and Flushness of Plates: Plus or minus 1/4 inch.
14. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch.

C. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.

1. Weld Plates: Plus or minus 1 inch.
2. Inserts: Plus or minus 1/2 inch.
3. Handling Devices: Plus or minus 3 inches.
4. Reinforcing Steel and Welded Wire Reinforcement: Plus or minus 1/4 inch where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch.
5. Reinforcing Steel Extending out of Member: Plus or minus 1/2 inch of plan dimensions.
6. Tendons: Plus or minus 1/4 inch, vertical; plus or minus 1 inch, horizontal.
7. Location of Rustication Joints: Plus or minus 1/8 inch.
8. Location of Opening within Panel: Plus or minus 1/4 inch.
9. Location of Flashing Reglets: Plus or minus 1/4 inch.
10. Location of Flashing Reglets at Edge of Panel: Plus or minus 1/8 inch.
11. Reglets for Glazing Gaskets: Plus or minus 1/8 inch.
12. Electrical Outlets, Hose Bibs: Plus or minus 1/2 inch.
13. Location of Bearing Surface from End of Member: Plus or minus 1/4 inch.
14. Allowable Rotation of Plate, Channel Inserts, and Electrical Boxes: 2-degree rotation or 1/4 inch maximum over the full dimension of unit.
15. Position of Sleeve: Plus or minus 1/2 inch.

2.13 FINISHES

A. Exposed faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample and as follows:

1. Design Reference Sample: Provided by Architect.

B. Finish exposed back surfaces of architectural precast concrete units to match face-surface finish.

C. Finish unexposed surfaces of architectural precast concrete units with as cast finish.

D. Finish all surfaces to receive sealant or membrane smooth and free from rock pockets, honeycombing, and other imperfections that may interfere with sealant or membrane.

2.14 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, ASTM C 1610/C 1610M, ASTM C 1611/C 1611M, ASTM C 1621/C 1621M, and ASTM C 1712.

B. Construction Manager will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

1. Allow Construction Manager's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

C. Strength of precast concrete units is considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

D. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M and ACI 318.

1. A minimum of three representative cores shall be taken from units of suspect strength, from locations directed by Architect.
2. Test cores in an air-dry condition.
3. Report test results in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports include the following:
   a. Project identification name and number.
   b. Date when tests were performed.
   c. Name of precast concrete fabricator.
   d. Name of concrete testing agency.
   e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

F. Defective Units: Discard and replace recast architectural concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

2.15 PRECAST CONCRETE STAIR TREADS

A. Comply with “Concrete Materials” article to provide concrete with a minimum 28-day compressive strength of 5000 psi and a total air content not less than 4 percent or more than 6 percent,

1. Flexural Strength: 2500 to 3000 psi in accordance with ASTM C 293.
2. Water Absorption: 3 to 4 percent absorption in accordance with ASTM C 67.

B. Reinforcing Bars: #3 - 3/8 inch (10mm) deformed rebar meeting the requirements of ASTM A 615, Grade 40.

C. Embedded Stair Tread Anchor Bolts: ASTM F 1554, Grade 36.

1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts with nuts for attaching and securing stair treads to stair framing.
2. Stair tread manufacturer's standard "shoulder nut" anchor bolt design to resist damage due to excessive torque stress on anchor bolt nut, or normal stair movement.

D. Water: Potable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.

B. Do not install precast concrete units until supporting cast-in-place concrete has attained minimum allowable design compressive strength and supporting steel or other structure is structurally ready to receive loads from precast concrete units.

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

3.2 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.

1. Install temporary steel or plastic spacing shims as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch.

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

1. Do not permit connections to disrupt continuity of roof flashing.

D. Welding: Comply with applicable requirements in AWS D1.1/D1.1M and AWS D1.4/D1.4M for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

1. Protect architectural precast concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
2. Welds not specified shall be continuous fillet welds, using no less than the minimum fillet as specified by AWS.
3. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and apply a minimum 4.0-mil-thick coat of galvanized repair paint to galvanized surfaces according to ASTM A 780/A 780M.
4. Clean weld-affected metal surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
5. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:
   a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   c. Twist-off Tension Control Bolt: ASTM F 1852.
   d. Direct-Tension Control Bolt: ASTM F 1852.
3. For slip-critical connections, use method and inspection procedure approved by Architect and coordinated with inspection agency.

F. Grouting or Dry-Packing Connections and Joints: Grout connections where required or indicated. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

B. Erect architectural precast concrete units level, plumb, square, and in alignment, without exceeding the following noncumulative erection tolerances:

1. Plan Location from Building Grid Datum: Plus or minus 1/2 inch.

2. Plan Location from Centerline of Steel: Plus or minus 1/2 inch.
3. Top Elevation from Nominal Top Elevation: As follows:
   a. Exposed Individual Panel: Plus or minus 1/4 inch.
   b. Non-Exposed Individual Panel: Plus or minus 1/2 inch.
   c. Exposed Panel Relative to Adjacent Panel: 1/4 inch.
   d. Non-Exposed Panel Relative to Adjacent Panel: 1/2 inch.
4. Support Elevation from Nominal Support Elevation: As follows:
   a. Maximum Low: 1/2 inch.
   b. Maximum High: 1/4 inch.
5. Maximum Plumb Variation over the Lesser of Height of Structure or 100 Feet: 1 inch.
6. Plumb in Any 10 Feet of Element Height: 1/4 inch.
7. Maximum Jog in Alignment of Matching Edges: 1/4 inch.
8. Joint Width (Governs over Joint Taper): Plus or minus 1/4 inch.
9. Maximum Joint Taper: 3/8 inch.
10. Joint Taper in 10 Feet: 1/4 inch.
11. Maximum Jog in Alignment of Matching Faces: 1/4 inch.
12. Differential Bowing or Camber, as Erected, between Adjacent Members of Same Design: 1/4 inch.
13. Opening Height between Spandrels: Plus or minus 1/4 inch.

3.4 FIELD QUALITY CONTROL

A. Architectural precast concrete installer shall provide field quality control by PCI certified staff and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

B. Testing Agency: Construction Manager will engage a qualified testing agency to perform tests and inspections and prepare test reports.

C. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.

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

E. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

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

3.5 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.6 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.
2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 45 00

SECTION 03 47 13 - TILT UP CONCRETE

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 specifies load-bearing, tilt-up concrete, including the following:
   1. Monolithic panels.

B. Related Sections include the following:

   1. Division 03 Section "Cast-in-Place Concrete" for slab-on-grade closure strip and general concrete construction.

1.3 DEFINITIONS

A. Face-down Surface: Concealed surface of as-cast, tilt-up panel formed against the casting slab.

B. Face-up Surface: Exposed upper surface of as-cast, tilt-up panel.

C. Reveal: Projection of the coarse aggregate from the matrix after exposure.

1.4 ACTION SUBMITTALS

A. Sustainable Design Documentation Submittals: Refer to section 01 8113.14 “Sustainable Design Requirements – LEED V4 BD+C”.
   1. Product Data: Documentation for Leadership Extraction Practices in the following:
      a. Regional/Local Multiplier Compliance
      b. Leadership Extraction Practices for Recycled Content

   2. Product Certificates: Provide the following:
      a. Environmental Product Declarations (EPD’s)
      b. Corporate Sustainability Reporting (CSR’s)

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

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

D. Shop Drawings: Detail fabrication and installation of tilt-up concrete units. Indicate panel locations, plans, elevations, dimensions, shapes, cross sections, and details of steel embedments.

1. Include steel reinforcement, detailing fabrication, bending, and placing. Include material, grade, bar schedules, stirrup spacing, bent-bar diagrams, arrangement, and supports of concrete reinforcement.
2. Include additional steel reinforcement to resist hoisting and erection stresses.
3. Include locations and details of hoisting points and lifting devices for handling and erection.
4. Casting Slab: Submit shop drawing showing size, type, and location of all casting slabs.
5. Forms: Submit shop drawing showing edge forms for panels.
6. Calculations: Submit complete signed and sealed engineering calculations. Include engineering analysis data of additional steel reinforcement and hoisting and erection details, signed and sealed by the qualified registered professional engineer in the state of Florida.
7. Indicate welded connections by AWS standard symbols. Detail cast-in inserts, connections, and joints, including accessories.

E. Sample: Prepare for approval of Architect/Engineer a minimum of one sample panel for each type of finish specified. Sample panel shall be 3 feet by 3 feet by 4 inches minimum thickness cast from a minimum 3 cubic yard truck load. Approved panels shall remain on the job site until the Architect gives instructions for removal and disposal. Rejected panels shall be disposed of off site.

F. Welding certificates.

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

1. Aggregates.

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

1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories.
4. Bondbreakers.
5. Curing compounds.
6. Inserts and embedments.

I. Field quality-control test and inspection reports.

J. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs a supervisor on Project who is an ACI-certified Tilt-up Supervisor.

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.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency 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 an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

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 the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

F. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," Sections 1 through 5, unless modified by requirements in the Contract Documents.

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

H. Mockups: Refer to specification 01 4339 Visual Mock-Up Requirements. Cast and erect tilt-up concrete panel mockups to demonstrate typical reveals, surface finishes, texture, color, and standard of workmanship.

1. Build mockup panels in the location and of the size indicated or, if not indicated, as directed by Architect.
2. In presence of Architect, damage part of an exposed surface for each finish, color, and texture required, and demonstrate materials and techniques proposed for repairs to match adjacent undamaged surfaces.

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 tilt-up 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. Tilt-up concrete subcontractor.

2. Review special inspection procedures; testing and inspecting agency procedures for field quality control; tilt-up concrete finishes and finishing; curing procedures; casting-slab construction, flatness and levelness, finish, and joint requirements; steel reinforcement installation tilt-up concrete repair procedures; and tilt-up concrete protection.

PART 2 - PRODUCTS

2.1 FORMS AND ACCESSORIES

A. Forms: Metal, dressed lumber, or other approved materials that are nonreactive with concrete and that will provide continuous, true, and smooth concrete surfaces.

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

C. Form Liners: Units of face design, texture, arrangement, and configuration indicated. Furnish with manufacturer's recommended liquid-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent surface treatments of concrete.

D. Reveal Strips: Metal, PVC, rubber, straight dressed wood, or plywood; with sides kerfed.

E. Sealer: Penetrating, clear, polyurethane wood form sealer formulated to reduce absorption of bleedwater and prevent migration of set-retarding chemicals from wood or plywood.

2.2 STEEL REINFORCEMENT

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

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Plain-Steel Wire: ASTM A 82galvanized.

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

F. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

G. Bar Supports: Manufactured according to CRSI's "Manual of Standard Practice" of plastic or CRSI Class 1 plastic-protected steel wire or Class 2 stainless-steel wire.

2.3 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 100 miles of Project site from aggregates that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout the Project:
   1. Portland Cement: ASTM C 150, Type I or I Supplement with the following:
      a. Fly Ash: ASTM C 618, Class C or F.
      b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Coarse Aggregate: ASTM C 33 coarse aggregate or better, graded. Provide aggregates from a single source.

D. Fine Aggregate: ASTM C 33 manufactured or natural sand, from same source for Project, free of materials with deleterious reactivity to alkali in cement.

E. Exposed Coarse Aggregate: Hard and durable; washed; free of material that reacts with cementitious material or causes staining; from a single source, as follows:
   1. Aggregate Sizes: 1/2 to 3/4 inch (13 to 19 mm) nominal.
   2. Gradation: Uniformly graded.

F. Water: Clean, fresh, drinkable, free of oils, acids or organic matter harmful to concrete.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

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-Reducingand Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

C. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, nonfading, and resistant to lime and other alkalis.
   1. Color: As selected by Architect from manufacturer's full range.

2.5 BONDBREAKERS

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 this Article.

B. Products: Subject to compliance with requirements, provide one of the following products listed in this Article.

C. Solvent-Borne, Chemically Reactive Bondbreaker: Penetrating polymerized solution containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.
   1. Burke by Edoco; Clean Lift 90 V.O.C.
   2. Conspec Marketing and Manufacturing Co., Inc., a Dayton Superior Company; Conspec CST VOC.
   3. Dayton/Richmond Concrete Accessories; Maxi Tilt.
   4. Dayton Superior Coporation; Sure Lift (J-6).

D. Solvent-Borne, Membrane-Forming Bondbreaker: Dissipating polymerized solution containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.
   1. Burke by Edoco; Super Bondbreaker V.O.C.
   2. Conspec Marketing and Manufacturing Co., Inc., a Dayton Superior Company; Tilt-Eez VOC.

E. Waterborne, Chemically Reactive Bondbreaker: Penetrating polymerized emulsion containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.
   1. Burke by Edoco; Super Tilt Bondbreaker W.B.
   2. Conspec Marketing and Manufacturing Co., Inc., a Dayton Superior Company; Conspec CST/WB.
   3. Dayton/Richmond Concrete Accessories; Maxi Tilt E.
   4. Dayton Superior Corporation; Sure-Lift WB (J-5).
   5. Nox-Crete Products Group, Kinsman Corporation; Silcoseal 2000F.

F. Waterborne, Membrane-Forming Bondbreaker: Dissipating polymerized emulsion containing no oils, waxes, paraffins, or silicones, and compatible with casting-slab curing compound.
   1. Burke by Edoco; Super Bondbreaker W.B.
   2. Conspec Marketing and Manufacturing Co., Inc., a Dayton Superior Company; Tilt-Eez WB.
   3. Dayton/Richmond Concrete Accessories; Rich Tilt E.

2.6 CURING MATERIALS

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

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

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

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.7 CONNECTION MATERIALS

A. Embedded Metal Items and Loose Hardware: Materials for securing tilt-up concrete panels together and to supporting and adjacent construction are specified in Division 05 Section "Metal Fabrications."

B. Loose Hardware: Materials for securing tilt-up concrete panels together and to supporting and adjacent construction are specified in Division 05 Section "Metal Fabrications."

C. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.

D. ASTM A 307 defines the term "studs" to include stud stock or threaded rods.

E. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts; and flat, unhardened steel washers.

F. Unheaded Carbon-Steel Rods and Nuts: ASTM A 36/A 36M, threaded rods with ASTM A 563, nuts.

G. Welded Headed Studs: AWS D1.1, Type B headed studs, and cold-finished, carbon-steel bars.

H. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

I. Chord Bar Sleeves: Tubular sheathing, plastic or moisture-resistance-treated cardboard.

J. Welding Electrodes: Comply with AWS standards.

K. Hot-Dip Galvanized Finish: Apply zinc coating to steel connections by hot-dip process, complying with ASTM A 123/A 123M or ASTM A 153/A 153M as applicable.

1. Zinc Repair Paint: SSPC-Paint 20.

2.8 LIFTING INSERTS AND ACCESSORIES

A. Furnish inserts, dowels, bolts, nuts, washers, and other items to be cast in panels for tilting and lifting.
   1. Manufacture inserts with feet of plastic, galvanized steel wire, plastic-tipped steel wire, or stainless-steel-tipped steel wire.

B. Furnish brace anchors and other accessories to be cast in panels and in casting slab for attaching bracing.
   1. Manufacture wall brace anchors and accessories with feet of galvanized steel wire, plastic-tipped steel wire, or stainless-steel-tipped steel wire.
   2. Manufacture floor brace anchors that will not penetrate vapor retarder under slab-on-grade.

2.9 BEARING PADS

A. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100 percent polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet; Type A Shore durometer hardness of 50 to 70, ASTM D 2240; and minimum tensile strength 2250 psi (15.5 MPa), ASTM D 412.

B. Random, Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer with a Type A Shore durometer hardness of 70 to 90, ASTM D 2240.

C. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded in elastomer with a Type A Shore durometer hardness of 80 to 100, ASTM D 2240.

D. High-Density Plastic Strips: Multimonomer, nonleaching plastic.

2.10 GROUT

A. 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.

B. 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, of consistency suitable for application.

2.11 MISCELLANEOUS MATERIALS

A. Chemical Surface Retarder: Water-soluble, liquid set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to depth of reveal or etch required of specified finish.

B. Form Retarder: Chemical liquid set retarder, for application on hardened horizontal concrete and capable of temporarily delaying final hardening of newly placed concrete to depth of reveal specified.

1. Mold Release: Solution specially formulated by manufacturer for use under form retarder.

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.

2.12 REPAIR MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

B. Patching Mortar: Dry-pack mix consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

2.13 CONCRETE MIXTURES

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

B. Proportion concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days unless noted otherwise.
2. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete according to ACI 301 requirements.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

D. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to ~~60~~ 75 minutes.

B. Project-Site-Produced Concrete: Measure, batch, and mix concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. Provide a batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time,

quantity, and amount of water added. Record panel locations where concrete is deposited.

PART 3 - EXECUTION

3.1 FORMS

A. Construct and brace formwork so tilt-up concrete panels are of size, shape, alignment, elevation, and position indicated.
   1. Construct forms on slab-on-grade or on temporary casting slab, at Contractor's option.
   2. Provide for openings, offsets, recesses, reveals, rustications, reglets, and blockouts.
   3. Place form liners accurately to provide finished surface texture indicated. Provide solid backing and supports to maintain stability of liners during concreting. Coat form liner with form-release agent.

B. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Use kerfed inserts, such as those forming reglets, rustications, and recesses, for easy removal.

C. Set edge forms for panels to achieve required panel thickness.

D. Chamfer exposed corners and edges, unless otherwise indicated, using chamfer strips fabricated to produce uniform, smooth lines and tight edge joints.

E. Coat contact surfaces of wood forms and chamfers with sealer before placing reinforcement.

3.2 BONDBREAKERS

A. Uniformly and continuously apply two coats of bondbreaker to casting-slab surfaces by power spray or roller according to manufacturer's written instructions, before placing steel reinforcement. Recoat areas subjected to moisture before drying. Maintain continuity of coating until concrete placement.

B. After placing steel reinforcement, touch up or recoat worn or damaged areas with bondbreaker. Do not splash or coat steel reinforcement and inserts.

3.3 FORM RETARDER

A. Uniformly and continuously apply form retarder to slab surfaces by power spray, roller, or brush according to manufacturer's written instructions, before placing steel reinforcement. Recoat areas subjected to moisture before drying. Maintain continuity of coating until concrete placement.
   1. Uniformly apply mold release according to manufacturer's written instructions and allow to dry before applying form retarder.

B. After placing steel reinforcement, touch up or recoat worn or damaged areas with form retarder. Do not splash or coat steel reinforcement and inserts.

3.4 REINFORCEMENT AND INSERTS

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

B. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
   1. Field weld reinforcement according to AWS D1.4, where indicated.
   2. Do not tack-weld crossing reinforcing bars.
   3. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

C. 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.

D. Accurately place and securely support embedded items, anchorages, inserts, cramps, retainers, bar chords and sleeves, and other items to be built into panels. Coordinate with other trades for installing cast-in items.

3.5 PANEL CASTING, GENERAL

A. Comply with ACI 301 for handling, placing, and consolidating concrete.

B. Maintain position of steel reinforcement, inserts, and anchors during concrete placement, consolidation, and finishing.

C. Screed panel surfaces to correct level with a straightedge and strike off.
   1. Begin initial floating before excess moisture or bleedwater appears on the surface. Use bull floats or darbies to form a uniform and open-textured surface plane free of humps or hollows. Do not disturb panel surfaces before beginning finishing operations.

D. Form chamfers at top edges of panel perimeters, openings, and similar locations not formed by chamfer strips, unless otherwise indicated.

E. Surface Defects: Limit visible surface defects to those permitted by TCA's "Tilt-up Concrete Association's Guideline Specifications" for Grade A, Architectural panel surfaces.

3.6 CASTING TOLERANCES

A. Cast tilt-up concrete panels without exceeding the following tolerances:

1. Height and Width of Panels:
   a. For Panels up to 20 Feet (6.1 m) Tall: 1/4 inch (6 mm) wide.
   b. For Panels 20 to 30 Feet (6.1 to 9.1 m) Tall: 3/8 inch (10 mm) wide.
   c. Each Additional 10 Feet (3.05 m) in Excess of 30 Feet (9.1 m) Tall: 1/8 inch (3 mm) wide.

2. Thickness: 3/16 inch (5 mm).

3. Skew of Panel or Opening: Difference in length of diagonals of 1/8 inch per 72 inches (3 mm per 1830 mm) with a maximum difference of 1/2 inch (13 mm).

4. Openings Cast into Panel:
   a. Size of Opening: 1/4 inch (6 mm).
   b. Location of Centerline of Opening: 1/4 inch (6 mm).

5. Location and Placement of Embedded Items:

   a. Inserts, Bolts, and Pipe Sleeves: 3/8 inch (10 mm).
   b. Lifting and Bracing Inserts: As required by manufacturer.
   c. Lateral Placement of Weld Plate Embedments: 1 inch (25 mm).
   d. Tipping and Flushness of Weld Plate Embedments: 1/4 inch (6 mm).

6. Deviation of Steel Reinforcement Cover: Maintain minimum cover required by ACI 301.

3.7 FACE-UP FINISHES

A. Float Finish: Consolidate surface of plastic concrete with power-driven floats or by hand floating. Restraighten and cut down high spots and fill low spots. Repeat float passes and restraighten until surface is left with a uniform, smooth, granular texture.

B. Trowel Finish: After applying float finish, apply first trowel finish and consolidate plastic concrete by hand trowel or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and is uniform in texture and appearance.

C. Trowel and Fine-Broom Finish: After applying float finish, apply a partial trowel finish to plastic concrete, stopping after second troweling. Immediately after second troweling, and when concrete is still plastic, slightly scarify the surface with a fine broom.
   1. Broom surface in a top-to-bottom direction.

D. Brushed Exposed-Aggregate Finish: Produce exposed-aggregate finish to exterior surface of concrete by washing and brushing before panel erection, as follows:
   1. Immediately after floating, broadcast a single layer of aggregate uniformly onto panel surface. Tamp seeded aggregate into plastic concrete, and float to embed aggregate with mortar cover of 1/16 inch (1.6 mm).
   2. Spray chemical surface retarder on panel according to manufacturer's written instructions.

3. Cover panel surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
4. Without dislodging aggregate, remove excess mortar by lightly brushing surface with stiff nylon-bristle broom.
5. Fine spray surface with water, and brush. Repeat water flushing and brushing cycle until cement film is removed from aggregate surfaces to depth required.

E. Abrasive-Blast, Exposed-Aggregate Finish: Produce exposed-aggregate finish to exterior surface of concrete by abrasive-blast finish before panel erection, as follows:
1. Immediately after floating, spray chemical surface retarder on panel surface according to manufacturer's written instructions.
2. Cover with plastic sheeting, sealing laps with tape, and remove after concrete has hardened.
3. Apply abrasive-blast finish using abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces as follows:

a. Light Exposure: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color; maximum reveal of 1/16 inch (1.6 mm).
b. Medium Exposure: Generally expose coarse aggregate with slight reveal; maximum reveal of 1/4 inch (6 mm).
c. Heavy Exposure: Expose and reveal coarse aggregate to a maximum projection of 1/3 of its diameter; reveal of 1/4 to 1/2 inch (6 to 13 mm).

4. Acid Cleaning: After abrasive blasting, clean surfaces with a 5 to 10 percent concentration of hydrochloric acid wash. Thoroughly neutralize and flush acid from finished surfaces with water under pressure. Protect casting slab and adjacent panels from acid wash.

3.8 FACE-DOWN FINISHES

A. Smooth, As-Cast Finish: Cast panel to produce a surface free of pockets, sand streaks, and honeycombs. Produce a surface appearance of uniform color and texture.

B. Form-Liner Finish: Cast panel over form liners placed, secured, and sealed over casting slab to produce a textured surface free of pockets, streaks, and honeycombs. Produce a surface appearance of uniform color and texture.

C. Abrasive-Blast, Exposed-Aggregate Finish: Produce exposed-aggregate finish to exterior surface of concrete by abrasive-blasting after panel erection.
1. Apply abrasive-blast finish using abrasive grit, equipment, application techniques, and cleaning procedures to expose aggregate and surrounding matrix surfaces as follows:

a. Light Exposure: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color; maximum reveal of 1/16 inch (1.6 mm).
b. Medium Exposure: Generally expose coarse aggregate with slight reveal; maximum reveal of 1/4 inch (6 mm).
c. Heavy Exposure: Expose and reveal coarse aggregate to a maximum projection of 1/3 of its diameter; reveal of 1/4 to 1/2 inch (6 to 13 mm).

D. Brushed Exposed-Aggregate Finish: Produce exposed-aggregate finish to exterior surface of concrete by washing and brushing after panel erection, as follows:
1. After panel erection and without dislodging aggregate, remove excess mortar by lightly brushing surface with stiff nylon-bristle broom.
2. Fine spray surface with water, and brush. Repeat water flushing and brushing cycle until cement film is removed from aggregate surfaces to depth required.

E. Bushhammer Exposed-Aggregate Finish: Allow concrete to cure at least 14 days before starting bushhammer surface finish operations.
1. Surface Continuity: Perform bushhammer finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work. Maintain required patterns or variances of cut as shown on Drawings or to match mockup.
2. Surface Cut: Maintain required depth of cut and general aggregate exposure. Use power tool with bushhammer attachments for large, flat surfaces, and use hand hammers for small areas, at corners and edges, and for restricted locations where power tools cannot reach.

F. Sand-Bed, Exposed-Aggregate Finish: Place selected exposed aggregate on a sand bed over casting slab before placing reinforcement, embedments, and concrete. After erecting panel, remove sand to expose aggregate.

3.9 CONCRETE PROTECTING AND CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures according to ACI 301.
1. Apply evaporation retarder in hot, dry, or windy weather to protect concrete from rapid moisture loss before and during finishing operations. Apply according to manufacturer's written instructions after screeding and bull floating concrete, but before float finishing.

B. Begin curing immediately after finishing concrete. Cure by one or a combination of the following methods according to ACI 308.1:
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.

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.

3.10 ERECTION

A. Use erection equipment with care to prevent damage to floor slabs and panels.

B. Lift, support, and erect panels only at designated lifting or supporting points indicated on Shop Drawings.

C. Do not erect panels until 75 percent of 28-day compressive strength of concrete has been verified.

D. Install tilt-up concrete panels level, plumb, square, and true. Place panels on leveled grout-setting pads or shims in correct position. Maintain joint width of 1/2 inch between panels.

1. Install tilt-up concrete panels with face-down surfaces exposed to exterior of building.

E. Temporarily brace and support panels securely in position against 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 panels are secured.

F. Anchor panels in place and, if indicated, to one another.
1. Weld steel connectors to steel supports and embedments indicated, complying with AWS D1.1.

G. Solidly grout-fill gaps between foundation system and bottom of panels.

3.11 FIELD QUALITY CONTROL

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

B. Inspections:
1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.

6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before erection of tilt-up panels.

C. Testing Services: Tests shall be performed according to ACI 301.

3.12 ERECTION TOLERANCES

A. Install tilt-up concrete panels without exceeding the following erection tolerances:
1. Joint Width Variation (Exterior Face): Without decreasing or increasing more than 50 percent from specified joint width, maintain joint width as follows:
a. For Panels up to 20 Feet (6.1 m) Tall: 1/4 inch (6 mm).
b. Each Additional 10 Feet (3.05 m) in Excess of 20 Feet (6.1 m) Tall: 1/8 inch (3 mm).

2. Joint Taper: Maximum 3/8 inch (10 mm) over length, but not greater than the following:
a. For Panels up to 20 Feet (6.1 m) Tall: 1/4 inch (6 mm).
b. Each Additional 10 Feet (3.05 m) in Excess of 20 Feet (6.1 m) Tall: 1/8 inch (3 mm)

3. Panel Alignment:
a. Alignment of Horizontal and Vertical Joints: 1/4 inch (6 mm).
b. Offset in Exterior Face of Adjacent Panels: 1/4 inch (6 mm).

3.13 FILLING AND REPAIRS

A. Patch holes and voids left by erecting and bracing inserts on tilt-up panels and slabs-on-grade. Cut or chip edges of voids perpendicular to concrete surface. Fill blockouts where indicated.
1. Clean, dampen with water, and brush-coat holes, voids, and blockouts with bonding agent. Fill and compact with patching mortar of a stiff consistency before bonding agent has dried.
2. Finish surfaces of fills and repairs to Architect's approval, with materials of same colors and textures as finishes on surrounding surfaces.

B. Repair damaged galvanized steel surfaces of connectors by cleaning and applying a coat of zinc repair paint.

C. Repair damage to tilt-up panels and slabs-on-grade resulting from tilt-up work, as directed by Architect.

D. Remove and replace tilt-up panels that do not comply with requirements in this Section.

E. Demolish and remove temporary concrete casting slabs.

END OF SECTION 03 47 13

SECTION 03 52 16 - LIGHTWEIGHT INSULATING CONCRETE

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cast-in-place vermiculite aggregate lightweight insulating concrete.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for requirements for normal-weight and structural lightweight concrete, including formwork, reinforcement, and concrete materials and mixes.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For lightweight insulating concrete.

1. Include plans, sections, and details showing roof slopes, thicknesses, and embedded insulation board.
2. Indicate locations of penetrations, perimeter terminations and curbs, control and expansion joints, and drains.

C. Design Mixtures: For each lightweight insulating concrete mixture.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For the following:

1. Cementitious materials.
2. Lightweight aggregates.
3. Foaming agents.
4. Admixtures.
5. Molded-polystyrene insulation board.

C. Evaluation Reports: For lightweight insulating concrete, from ICC-ES.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. NRDCA Installer Qualifications: A firm that has been evaluated by UL and found to comply with requirements of NRDCA's Lightweight Insulating Concrete Roof Deck Contractors Accreditation Program.

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1.7 FIELD CONDITIONS

A. Do not place lightweight insulating concrete unless ambient temperature is at least 40 deg F and rising.

B. Do not place lightweight insulating concrete during rain or snow or on surfaces covered with standing water, snow, or ice.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. FM Global Listing: Lightweight insulating concrete along with other roofing components shall comply with requirements in FM Global 4454 as part of a roof assembly, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable.

2.2 AGGREGATE LIGHTWEIGHT INSULATING CONCRETE

A. Produce aggregate lightweight insulating concrete using the minimum amount of water necessary to produce a workable mix.

1. Do not exceed maximum air content recommended by aggregate manufacturer.

B. Vermiculite Aggregate Mix: Lightweight insulating concrete produced from cementitious materials, water, air-entraining admixture, and vermiculite mineral aggregates complying with ASTM C 332, Group I.

1. Asbestos Content: No detectable asbestos as determined by method specified in 40 CFR 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."
2. As-Cast Unit Weight: 44 to 60 lb/cu. ft. at point of placement, when tested according to ASTM C 138/C 138M.
3. Oven-Dry Unit Weight: 22 to 28 lb/cu. ft., when tested according to ASTM C 495.
4. Compressive Strength: Minimum 125 psi, when tested according to ASTM C 495.

5. Cement-to-Aggregate Ratio, by Volume: 1:6.

2.3 MATERIALS

A. Cementitious Material: Portland cement, ASTM C 150/C 150M, Type I. Supplement with fly ash, ASTM C 618, Class C or F.

B. Water: Clean, potable.

C. Joint Filler: ASTM C 612, Class 2, glass-fiber type; compressing to one-half thickness under a load of 25 psi.

D. Steel Wire Mesh: Cold-drawn steel wire, galvanized, 0.041-inch diameter, woven into 2-inch hexagonal mesh, and reinforced with a longitudinal 0.062-inch-diameter wire spaced 3 inches apart.

E. Molded-Polystyrene Insulation Board: ASTM C 578, Type I, 0.90-lb/cu. ft. minimum density.

1. Provide units with manufacturer's standard keying slots or holes of 3 to 4 percent of board's gross surface area.

2.4 DESIGN MIXTURES

A. Prepare design mixtures for each type and strength of lightweight insulating concrete by laboratory trial batch method or by field-test data method. For trial batch method, use a qualified independent testing agency for preparing and reporting proposed mixture designs.

1. Limit use of fly ash to not exceed 25 percent of portland cement by weight.

B. Limit water-soluble chloride ions to the maximum percentage by weight of cement or cementitious material permitted by ACI 301.

PART 3 - EXECUTION

3.1 PREPARATION

A. Control Joints: Install control joints at perimeter of roof deck and at junctures with vertical surfaces, including curbs, walls, and vents, for full depth of lightweight insulating concrete. Fill control joints with joint filler.

1. Provide 1-inch-wide control joints for roof dimensions up to 100 feet in length; 1-1/2-inch-wide control joints for roof dimensions exceeding 100 feet.

B. Wire Mesh: Place steel wire mesh with longest dimension perpendicular to steel deck ribs. Cut mesh to fit around roof openings and projections. Terminate mesh at control joints. Lap sides and ends of mesh at least 6 inches.

3.2 MIXING AND PLACING

A. Mix and place lightweight insulating concrete according to manufacturer's written instructions, using equipment and procedures to avoid segregation of mixture and loss of air content.

B. Install insulation board according to lightweight insulating concrete manufacturer's written instructions. Place insulation board in wet, lightweight insulating concrete slurry poured a minimum of 1/8 inch over the structural substrate. Ensure full contact of insulation board with slurry. Stagger joints and tightly butt insulation boards. Allow slurry coat to set prior to placing remaining thickness of lightweight insulating concrete.

1. Install insulation board in a stair-step configuration with a maximum step-down of 1 inch.

C. Deposit and screed lightweight insulating concrete in a continuous operation until an entire panel or section of roof area is completed. Do not vibrate or work mix except for screeding or floating. Place to depths and slopes indicated.

D. Finish top surface smooth, free of ridges and depressions, and maintain surface in condition to receive subsequent roofing system.

E. Begin curing operations immediately after placement, and air cure for not less than three days, according to manufacturer's written instructions.

F. If ambient temperature falls below 32 deg F, protect lightweight insulating concrete from freezing and maintain temperature recommended by manufacturer for 72 hours after placement.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to sample materials and perform tests and inspections.

B. Testing of samples of lightweight insulating concrete obtained according to ASTM C 172/C 172M, except as modified by ASTM C 495, shall be performed according to the following requirements:

1. Determine as-cast unit weight during each hour of placement, according to ASTM C 138/C 138M.
2. Determine oven-dry unit weight and compressive strength according to ASTM C 495. Make a set of at least six molds for each day's placement, but not less than one set of molds for each 5000 sq. ft. of roof area.
3. Perform additional tests when test results indicate that as-cast unit weight, oven-dry unit weight, compressive strength, or other requirements have not been met.
    a. Retest cast-in-place lightweight insulating concrete for oven-dry unit weight and compressive strength.

C. Prepare test and inspection reports.

END OF SECTION 03 52 16

SECTION 04 22 00 - CONCRETE 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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Embedded flashing.
6. Miscellaneous masonry accessories.
7. Masonry-cell fill.

B. Related Requirements:

1. Section 05 12 00 "Structural Steel Framing" for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
2. Section 07 19 00 "Water Repellents" for water repellents applied to unit masonry assemblies.
3. Section 07 62 00 "Sheet Metal Flashing and Trim" for 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 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Product Data: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C” for Leadership Extraction Practices for the following:
   a. Regional/Local Multiplier Compliance

b. Leadership Extraction Practices for Recycled Content

2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD's)
   b. Corporate Sustainability Reporting (CSR's) this will depend on the manufacturer sections

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
4. Control joint locations corresponding with joints in cladding materials where applicable.

C. Samples for Verification: For each type and color of the following:

1. Exposed CMUs.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.
   a. Include data on material properties.
2. Grout mixes. Include description of type and proportions of ingredients.
3. Reinforcing bars.
4. Joint reinforcement.
5. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar. 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/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

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

1.8 QUALITY ASSURANCE

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

B. Mockups: Build mockups as indicated in Section 01 43 39 "Visual Mock-up Requirements".

1. Build mockup of typical wall area as directed by Architect.
2. Protect accepted mockups from the elements with weather-resistant membrane.

3. 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 Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

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

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

1.10 FIELD 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. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.

B. Do not apply uniform 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. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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.

B. 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.

2.2 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.

1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

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

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

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

D. Sustainability Requirements

1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 10 percent.
   a. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.
2. Regional Materials: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C” for CMUs manufactured within 100 miles of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 100 miles of Project site.

2.4 CONCRETE MASONRY UNITS

A. 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 bullnose units for outside corners unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514/E 514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
    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) ACM Chemistries.
        2) BASF Corporation; Construction Systems.
        3) Grace Construction Products.

C. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
2. Density Classification: Normal weight.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.

D. Pre-faced CMUs: Lightweight hollow concrete units complying with ASTM C 90, with manufacturer's standard smooth resinous facing complying with ASTM C 744.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi (14.8 MPa).
2. Size: Manufactured to dimensions specified in "CMUs" Paragraph but with pre-faced surfaces having 1/16-inch- (1.5-mm-) wide returns of facing to create 1/4-inch- (6.5-mm-) wide mortar joints with modular coursing.
3. Colors and Patterns: As selected by Architect from manufacturer's full range.

2.5 MASONRY LINTELS

A. General: Provide one of the following:

B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, 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.

2.6 INSULATED CONCRETE MASONRY UNITS

A. Insulated Concrete Masonry Units: Pre-assembled structural concrete masonry units composed of an inner component concrete masonry shell that is continuously thermally broken from the outer concrete shell. The thermal break is expanded polystyrene (EPS) closed cell insulation. The insulation EPS is held firmly between the two concrete block shells by dove tail slots and internal stainless-steel metal anchors molded into the EPS inserts, creating a cohesive and tightly fitting single unit.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Northfield, an Oldcastle Company; InsulTech Insulated Concrete Masonry Units or comparable approved product meeting all requirements including sustainability requirements.

a. Refer to Sections 01 25 00 “Substitution Procedures” and 01 60 00 “Product Requirements” for comparable product requirements.

B. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2000 psi. Weight Classification: Medium weight with density not to exceed 125 lbs. per cubic foot concrete.

C. Molded-Polystyrene Insulation:

1. Rigid, cellular thermal insulation formed by the expansion of polystyrene-resin beads or granules in a closed mold to comply with ASTM C 578, Type I.
2. Provide specially shaped insulation designed for installing in face shells of insulated masonry units and providing continuous thermal barrier across head joints, including corner units. Provide an adhesive applied to EPS insert which serves as a continuous air barrier. Provide compliant closed cell gasket material to provide air tightness and continuous insulation across the bed joints.

D. Special Shapes:

1. Provide special shapes as follows: Provide shapes including right and left corner and L corner units, jambs, half-size shapes, solid bottom bond beams, and other special conditions manufactured as pre-assembled units with EPS, complying with above requirements, and match exposed finish of insulated concrete masonry units.
2. Provide square-edged units for outside corners. Provide EchelonMasonry.com separate 8” unit matching exposed finish to be installed at base of wall, above doors and windows, and other areas where flashing is required. Provide exterior face shell preassembled with 3” EPS with inside face shaved flush to be installed at base of wall, above doors and windows, and other areas where flashing is required.

2.7 THERMALLY IMPROVED CONCRETE MASONRY UNITS

A. Thermally improved concrete masonry units: Specially formed concrete masonry units with pre-formed, molded expanded polystyrene inserts.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Omni Block Concrete Masonry Units or comparable approved product meeting all requirements including sustainability requirements.

B. Provide special block sizes and shapes required or as shown on Drawings.

~~2.7~~2.8 CMU INSULATION

A. Where indicated, units shall contain rigid, specially shaped, cellular thermal insulation units complying with ASTM C 578, Type I, designed for installing in cores of masonry units.

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. Concrete Block Insulating Systems.
   b. Shelter Enterprises Inc.

~~2.8~~2.9 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150/C 150M, 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.

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

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

D. 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-thick, use aggregate graded with 100 percent passing the No. 16 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.

E. Aggregate for Grout: ASTM C 404.

F. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ACM Chemistries.
   b. BASF Corporation - Admixture Systems.
   c. Grace Construction Products.

G. Water: Potable.

~~2.9~~2.10 REINFORCEMENT

A. Provide Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

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

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

D. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized carbon steel.
2. Exterior Walls: Stainless steel.
3. Wire Size for Side Rods: 0.187-inch diameter.

4. Wire Size for Cross Rods: 0.187-inch diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

~~2.10~~2.11 TIES AND ANCHORS

A. General: Ties and anchors shall extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.

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

1. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.

C. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

D. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M.

~~2.11~~2.12 EMBEDDED FLASHING MATERIALS

A. Single-Wythe CMU Flashing

1. System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.
   a. Basis-of-Design Product: Subject to compliance with requirements, provide Mortar Net Solutions, BlockFlash or comparable approved product meeting all requirements including sustainability requirements.
      1) Refer to Sections 01 25 00 “Substitution Procedures” and 01 60 00 “Product Requirements” for comparable product requirements.
   b. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 40 percent.
      1) Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Flexible Thru-Wall Flashing

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 1.0 mm (40 mil).
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Carlisle Coatings & Waterproofing Inc.

2) GCP Applied Technologies Inc. (formerly Grace Construction Products).
3) W. R. Meadows, Inc.

b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

~~2.12~~2.13 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.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 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 felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

D. Weep/Cavity Vent Products: Use the following unless otherwise indicated:

1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Advanced Building Products Inc.
      2) Keene Building Products.
      3) Mortar Net Solutions.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Configuration: Strips to fit within individual masonry cells.

~~2.13~~2.14 MASONRY-CELL FILL

A. Lightweight-Aggregate Fill: ASTM C 331/C 331M.

~~2.14~~2.15 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. 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.

1. For masonry below grade or in contact with earth, use Type S.

2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type N.
4. For interior nonload-bearing partitions, Type O may be used instead of Type N.
5. For mortar parge coats, use Type S or Type N.

C. 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 TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches 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 the Work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.
4. Verify that substrates are free of substances that would impair mortar bond.

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

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

3.2 INSTALLATION, GENERAL

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

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

C. 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.

3.3 FIELD QUALITY CONTROL

A. Concrete unit masonry installer shall provide field quality control by staff having adequate prior experience and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
    a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
    b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

3.4 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 or minus 1/4 inch.
    2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
    3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch 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, or 1/2-inch 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, 1/4 inch in 20 feet, or 1/2-inch maximum.
    3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch 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, 1/4 inch in 20 feet, or 1/2-inch maximum.
    5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
    6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
    7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:
    1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
    2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
    3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
    4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.5 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: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by stepping 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 under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

H. Build nonload-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 clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 43 "Joint Firestopping."

3.6 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

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

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

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

E. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.7 MASONRY-CELL FILL

A. Pour lightweight-aggregate fill into cavities to fill void spaces. Maintain inspection ports to show presence of fill at extremities of each pour area. Close the ports after filling has been confirmed. Limit the fall of fill to one story high, but not more than 20 feet.

3.8 MASONRY-JOINT REINFORCEMENT

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

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches 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 1/2-inch-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 o.c. vertically and 36 inches o.c. horizontally.

3.10 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:

1. Install preformed control-joint gaskets designed to fit standard sash block.
2. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

3.11 LINTELS

A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.12 FLASHING

A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall 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 lintels, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 3 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
4. Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

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

3.13 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 TMS 602/ACI 530.1/ASCE 6.

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 TMS 602/ACI 530.1/ASCE 6 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.

3.14 FIELD QUALITY CONTROL

A. Testing Prior to Construction: One set of tests.

3.15 PARGING

A. Parge exterior faces of masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch (19 mm). Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot (3 mm per 300 mm). Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

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 uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent 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.
5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

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 04 22 00

SECTION 05 1200 - 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. Section Includes:
1. Structural steel.
2. Field-installed shear connectors.
3. Grout.

B. Related Requirements:
1. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for surface-preparation and priming requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Heavy Sections: Rolled and built-up sections as follows:
1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

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

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Documentation Submittals: Refer to section 01 8113.14 “Sustainable Design Requirements – LEED V4 BD+C”.
1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Regional/Local Multiplier Compliance – where possible.
   b. Leadership Extraction Practices for Recycled Content

2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Corporate Sustainability Reporting (CSR’s)

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

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

E. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator and shop-painting applicators.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats or fire proofing applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.
7. Rods
8. Clevis

F. Survey of existing conditions.

G. Source quality-control reports.

1.8 QUALITY ASSURANCE

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

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE for building over 200,000 sf, ASC, LST, Pedestrian Bridge. Category CSE for reamining steel structures.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

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

E. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 360.
   3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

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

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
   1. Select and complete connections using schematic details indicated and AISC 360.
   2. Use Load and Resistance Factor Design; data are given at factored-load level or Allowable Stress Design; data are given at service-load level., refer to the drawings notes for each building

B. Moment Connections: Type FR, fully restrained.

C. Construction: Combined system of moment frame, braced frame, and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:
   1. W-Shapes: 60 percent.
   2. Channels, Angles-Shapes: 60 percent.
   3. Plate and Bar: 85 percent.
   4. Cold-Formed Hollow Structural Sections: 30 percent.
   5. Steel Pipe: 25 percent.
   6. All Other Steel Materials: 25 percent.

B. W-Shapes: ASTM A 992, Grade 50.

C. Channels, Angles, M-Shapes: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 572/A 572M, Grade 50.

E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade C, structural tubing.

F. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
   1. Weight Class: As shown on Contract drawings
   2. Finish: Black except where indicated to be galvanized.

G. Seamless Carbon and Alloy Steel Mechanical Tubing ASTM A 519 Grade 1096

H. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.

I. Steel Forgings: ASTM A 668/A 668M.

J. Welding Electrodes: Comply with AWS requirements.

2.3 High Strength Tension Rods System:

A. Steel rods shall be carbon steel and shall conform to DIN EN 10025.
   1. For rods ½" in diameter or less provide S355 (51 ksi yield) steel
   2. For rods greater than ½" in diameter provide S460 (66 ksi yield) steel.
   3. Fabricate rods with right hand threads and left hand threads on alternate ends.

B. Fittings shall be cast steel and shall be capable of developing 1.5 times the full breaking strength of the steel rod.

   1. For rods ½" in diameter or less material shall be forged carbon steel S355J2 DIN EN 10025
   2. For rods greater than ½" in diameter material shall be cast steel G20 Mn5+QT DIN EN 10293.

C. Provide a complete system from one of the following or approved equal:

1. Halfen Detan rod system, Halfen, USA, Inc., 8521 FM 1976, P.O. Box 547, Converse, TX 78109
2. Maccalloy 460 rod system, Maccalloy, Caxton Way, Dinnington, Sheffield, S25 3QE, UK.
3. Pfeifer Tension Rod System Typ 860, Pfeifer Seil- und Hebetechnik GmbH, Dr.-Karl-Lenz-Strasse 66, DE-87700 Memmingen.

2.4 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Retain "Direct-Tension Indicators" Subparagraph below if applicable. If using corrosion-resisting (weathering) steel, revise Type 325 to Type 325-3; ASTM F 959M does not include a designation for corrosion-resistant steel.

2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.

1. Finish: Mechanically deposited zinc coating] [Hot-dip or mechanically deposited zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain (interior) and Mechanically deposited zinc coating (exterior).

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

F. Headed Anchor Rods: ASTM F 1554, Grade 55 unless shown otherwise on contract drawings, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 Type 1, hardened carbon steel.
4. Finish: Plain (interior) and Mechanically deposited zinc coating, ASTM B 695, Class 50 (exterior).

G. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM A 36/A 36M carbon steel.
3. Finish: Plain and Mechanically deposited zinc coating, ASTM B 695, Class 50.

H. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

J. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

K. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint. Refer to drawings.
1. Provide slide bearing system from one of the following or approved equal:
   a. Con-Serv Inc. - Con Slide
   b. Steel Supply Company
2. Mating Surfaces: PTFE and mirror-finished stainless steel.
3. Coefficient of Friction: Not more than 0.05
4. Design Load: Not less than 4,000 psi.
5. Total Movement Capability: See architectural drawings

L. Urethane Springs: Compression Springs machined from Urethane rod stock or precision cast. Outer diameter and length as shown on Contract drawings. Inner diameter to be an interference fit for the rod diameter shown on Contract drawings.

1. Fabricate from 60A Durometer urethane, natural color.
2. Provide compression springs from one of the following or approved equal:
   a. Gallagher Corp., 3908 Morrison Dr, Gurnee, IL 60031
   b. Precision Urethane, 612 3rd St, Hempstead, TX 77445
   c. Century Spring Corp., 5959 Triumph Street, Commerce, CA 90040

2.5 PRIMER

A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

~~B. Primer: SSPC-Paint 25, Type II, zinc oxide, alkyd, linseed oil primer.~~

B. Galvanizing Repair Paint: ASTM A 780/A 780M.

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

~~C.~~

2.6 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

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

C. Bolt Holes: Cut, drill, 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." and SSPC-SP 2, "Hand 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/D1.1M and manufacturer's written instructions.

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

H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 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: Snug tightened unless shown otherwise on the drawings.

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

2.9 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.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

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: As per the primer manufacturer’s recommendation.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.10 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 and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels, shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.
   3. Galvanize steel to be embedded in concrete or exposed to exterior.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified testing agency to perform shop tests and inspections.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   3. Ultrasonic Inspection: ASTM E 164.
   4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M 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 according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

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

3.2 PREPARATION

A. Work shown on Contract drawings indicates final conditions only. The Contractor shall be responsible for insuring the stability of the construction during construction.

B. 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.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.

3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

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

H. 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/D1.1M 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: Snug tightened unless otherwise noted.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tab, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 PREFABRICATED BUILDING COLUMNS

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

3.6 FIELD QUALITY CONTROL

A. Special Inspections: **Owner will engage** a qualified special inspector to perform the following special inspections:
   1. Verify structural-steel materials and inspect steel frame joint details.
   2. Verify weld materials, inspect welds and perform non-destructive testing.
   3. Verify connection materials and inspect high-strength bolted connections.

B. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M. 100% visual inspection of all fillet welds including fit up and partial penetration welds with 25% subject to Liquid Penetrant or Mag Particle and 100% UT testing of full pen.
   1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures.
      a. Liquid Penetrant Inspection: ASTM E 165.
      b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
      c. Ultrasonic Inspection: ASTM E 164.
      d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M 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 according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.7 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

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

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

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 05 1200

SECTION 05 2100 - STEEL JOIST 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. Section Includes:
   1. K-series steel joists.
   2. KCS-type K-series steel joists.
   3. LH- and DLH-series long-span steel joists.
   4. Joist girders.
   5. Joist accessories.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for installing bearing plates in concrete.
   2. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.
   3. Section 051200 "Structural Steel Framing" for field-welded shear connectors.

1.3 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

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

B. Sustainable Design Documentation Submittals: Refer to section 01 8113.14 “Sustainable Design Requirements – LEED V4 BD+C”.
   1. Product Data: Documentation for Leadership Extraction Practices in the following:
      a. Regional/Local Multiplier Compliance
      b. Leadership Extraction Practices for Recycled Content

   2. Product Certificates: Provide the following:

a. Environmental Product Declarations (EPD's)
b. Corporate Sustainability Reporting (CSR's)

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

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

F. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications**."**
1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

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

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications**."**

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Canam Steel Corporation
   2. Nucor, Vulcraft
   3. Or approved substitution

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
   1. Use ASD; data are given at service-load level.
   2. Design special joists to withstand design loads with live-load deflections no greater than the following:
      a. Roof Joists: Vertical deflection of 1/240 of the span.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 60 percent.

2.3 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
   1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Provide holes in chord members for connecting and securing other construction to joists.

C. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

D. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

E. Do not camber joists.

F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.4 LONG-SPAN STEEL JOISTS

A. Manufacture steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as follows:

1. Joist Type: LH-series steel joists and DLH-series steel joists.
2. End Arrangement: Underslung unless noted otherwise.
3. Top-Chord Arrangement: Parallel and Pitched, as noted on the drawings

B. Provide holes in chord members for connecting and securing other construction to joists.

C. Camber long-span steel joists as indicated.

D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.5 JOIST GIRDERS

A. Manufacture joist girders according to "Standard Specification for Joist Girders" in SJI's "Specifications," with steel-angle top- and bottom-chord members; with end and top-chord arrangements as follows:
1. End Arrangement: Underslung or Underslung with bottom-chord extensions unless noted otherwise.
2. Top-Chord Arrangement: As shown on the drawings

B. Provide holes in chord members for connecting and securing other construction to joist girders.

C. Camber joist girders as indicated.

D. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.6 PRIMERS

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

B. Primer: Provide shop primer that complies with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

2.7 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist,

chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Fabricate steel bearing plates from ASTM A 36/A 36M steel with integral anchorages of sizes and thicknesses indicated. Shop prime paint

C. Durnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.
   1. Finish: Plain, uncoated.

D. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
   1. Finish: Plain.

E. Welding Electrodes: Comply with AWS standards.

F. Galvanizing Repair Paint: ASTM A 780/A 780M.

G. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.8 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

D. Shop priming of joists and joist accessories is specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications**,** joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. The following requirements are intended to supplement GOAA’s speciation 01 4529 Structural Testing and Inspection. Where conflict exist specification 01 4529 Structural Testing and Inspection shall govern.

B. Testing Agency: **Contractor will engage** a qualified testing agency to perform tests and inspections.

C. Visually inspect field welds according to AWS D1.1/D1.1M.
1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E 165/E 165M.
    b. Magnetic Particle Inspection: ASTM E 709.
    c. Ultrasonic Testing: ASTM E 164.
    d. Radiographic Testing: ASTM E 94.

D. Visually inspect bolted connections.

E. Prepare test and inspection reports.

3.4 PROTECTION

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

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

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

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099123 "Interior Painting." Section 099600 "High-Performance Coatings."

END OF SECTION 05 2100

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. Section Includes:
   1. Roof deck.
   2. Composite floor deck.
   3. Noncomposite form deck.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
   2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
   3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

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

B. Sustainable Design Documentation Submittals: Refer to section 01 8113.14 “Sustainable Design Requirements – LEED V4 BD+C”.
   1. Product Data: Documentation for Leadership Extraction Practices in the following:
      a. Regional/Local Multiplier Compliance
      b. Leadership Extraction Practices for Recycled Content

   2. Product Certificates: Provide the following:
      a. Environmental Product Declarations (EPD’s)

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

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

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

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

D. Evaluation Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. The following requirements are intended to supplement GOAA’s speciation 01 4529 Structural Testing and Inspection. Where conflict exist specification 01 4529 Structural Testing and Inspection shall govern.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

D. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" refer to drawings for building ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

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

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 30 percent.

2.2 ROOF DECK

A. Manufacturers:
   1. Canam Steel Corporation
   2. Nucor, Vulcraft
   3. Epic Metals
   4. Roof Deck Inc.
   5. Or approved substitution

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 80, G90 zinc coating.
   2. Deck Profile: Type WR wide rib or As indicated on the drawings.
   3. Dove Tail Deck Profile: As indicated on drawings.
      a. Manufactures:
         1) Metal Dek Group – Versa Dek 3.5LS Acoustical
         2) Verco Deck – 3 ½" Dove Tail Acoustical
         3) Epicore – ~~3.5ERA~~Toris4A
   4. Profile Depth: 1-1/2 inches or as indicated on the drawings (2", 3" and 3 ½")
   5. Design Uncoated-Steel Thickness: 0.0358 inch or as indicated on the drawings.
   6. Span Condition: Double span.
   7. Side Laps: Overlapped or interlocking seam at Contractor's option. The contractor shall follow FM Global for side lap installation

2.3 COMPOSITE FLOOR DECK

A. Manufacturers:
   1. Canam Steel Corporation
   2. Nucor, Vulcraft
   3. Or approved substitution

B. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
   1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50, G90 zinc coating.
   2. Profile Depth: 2 inches, 3 inches or as indicated on the drawings.

3. Design Uncoated-Steel Thickness: 0.0474 inch or as indicated on the drawings.
4. Span Condition: ~~Double span~~As indicated on the drawings.

2.4 NONCOMPOSITE FORM DECK (Refer to drawings)

A. Manufacturers:
1. Xanam Steel Corporation
2. Nucor, Vulcraft
3. Or approved substitution

B. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 40, G90 zinc coating.

2. Profile Depth: 2 and 3 inches.
3. Design Uncoated-Steel Thickness: 0.0358 inch or as indicated on the drawings.
4. Span Condition: Double span or as indicated on the drawings.
5. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.5 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 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

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

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.

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

H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

I. Galvanizing Repair Paint: ASTM A 780/A 780M.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 INSTALLATION, GENERAL

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

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

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

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

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

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

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

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

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

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 long, and as follows:
   1. Weld Spacing: As indicated on drawings

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 18 inches, or as indicated on the drawings and as follows:

   1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches, with end joints as follows:

   1. End Joints: Lapped 2 inches minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one mechanical fastener at each corner.
   1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld 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.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 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: 5/8 inch or as indicated on drawings, nominal.
   2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
   3. Weld Spacing: Space and locate welds as indicated.

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

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

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 2 inches, with end joints as follows:
   1. End Joints: Lapped.

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

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

3.5 FIELD QUALITY CONTROL

A. The following requirements are intended to supplement GOAA's speciation 01 4529 Structural Testing and Inspection. Where conflict exist specification 01 4529 Structural Testing and Inspection shall govern.

B. Testing Agency: **Contractor will engage** a qualified testing agency to perform tests and inspections.

C. Field welds will be subject to inspection.

D. Prepare test and inspection reports.

3.6 PROTECTION

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

END OF SECTION 05 3100

SECTION 05 40 00 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior non-load-bearing wall framing.
2. Exterior soffit framing.
3. Interior non-load-bearing wall framing as required to meet performance criteria.

B. Related Requirements:

1. Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
2. Section 05 50 00 "Metal Fabrications" for masonry shelf angles and connections.
3. Section 07 42 13.23 “Metal Composite Material Wall Panels” for sheet metal zee component of wall assemblies.
4. Section 09 21 16.23 "Gypsum Board Shaft Wall Assemblies" for interior non-load-bearing, metal-stud-framed, shaft-wall assemblies.
5. Section 09 22 16 "Non-Structural Metal Framing" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.
6. Section 09 24 00 “Cement Plastering” for cold-formed metal zees for cement plaster attachment.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

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

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Regional/Local Multiplier Compliance
   b. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Shop Drawings:

1. Include layout, spacing, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Test Reports: For each listed product, for tests performed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Mechanical fasteners.
4. Vertical deflection clips.
5. Horizontal drift deflection clips
6. Miscellaneous structural clips and accessories.

D. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

E. Delegated-Design Submittal: For cold-formed steel framing.

1.5 QUALITY ASSURANCE

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

B. Professional Engineer Qualifications: A professional Licensed Structural 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: Qualified according to ASTM E 329 for testing indicated.

D. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

E. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

F. 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 – Header Design."

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design exterior curtain wall and window wall metal stud framing details, shop drawings, and calculations for Deferred Submittal to obtain supplemental permits and approval from Authorities Having Jurisdiction. Design shall include framing for all non-full height elements, bulkheads, soffits, and exterior walls incorporating metal stud framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As follows:
   a. Dead Loads: Weights of materials and construction.
   b. Live Loads: As indicated on drawings.
   c. Seismic Loads: As indicated on drawings.
2. Design Wind Loads: As indicated on drawings.
3. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
   a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.
   b. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height.
   c. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
4. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
5. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as indicated on Drawings.
6. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Design Standards:

1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

E. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 COLD-FORMED STEEL FRAMING, GENERAL

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

1. Coating: G90 or equivalent.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

C. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

2.3 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. Clarkwestern Dietrich Building Systems LLC
2. MBA Building Supplies
3. Steel Structural Products

2.4 EXTERIOR AND INTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Minimum Flange Width: 1-3/8 inches.
3. Minimum Stud Depth: 3-5/8 inches.
4. Section Properties: As required by design requirements.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: Matching steel studs.

C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing

free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:

E. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure.
2. Inner Track: Of web depth indicated.

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

G. Z-Furring: Manufacturer's standard Z-shaped steel furring, of web depths indicated and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Minimum Flange Width: 1-1/4 inches.
3. Web Depth: As indicated.
4. Section Properties: As required by design requirements.

2.5 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0428 inch.
2. Flange Width: 1-5/8 inches, minimum.
3. Retain "Section Properties" Subparagraph below if not assigning design responsibility to Contractor. If retaining, indicate whether design is based on gross or effective section properties.
4. Section Properties: As required by design requirements.

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, including but not limited to the following:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Hole reinforcing plates.
10. Backer plates.

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. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel headless, hooked bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.

D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

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 MIL-P-21035B.

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. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

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

2.9 FABRICATION

A. Fabricate cold-formed steel 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.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

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

3.3 INSTALLATION, GENERAL

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

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

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

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

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

E. 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.

F. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

G. Install insulation, specified in Section 07 21 00 "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.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

I. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

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

3.4 EXTERIOR AND INTERIOR NON-LOAD-BEARING WALL INSTALLATION

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

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As required by design requirements, 16 inches maximum.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single deep-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
4. Connect drift clips to cold-formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   a. Install solid blocking at 96-inch centers.
2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

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

3.5 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.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 40 00

SECTION 05 50 00 - 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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Steel framing and supports for overhead doors and grilles.
2. Steel framing and supports for countertops.
3. Steel tube reinforcement for low partitions.
4. Steel framing and supports for mechanical and electrical equipment.
5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
6. Elevator machine beams, hoist beams, and divider beams.
7. Steel shapes for supporting elevator door sills.
8. Shelf angles.
9. Metal ladders.
10. Ladder safety cages.
11. Metal ship’s ladders.
12. Metal crossovers.
13. Elevator pit sump covers.
14. Miscellaneous steel trim including steel angle corner guards and loading-dock edge angles.
15. Metal bollards.
16. Pipe guards.
17. Loose bearing and leveling plates for applications where they are not specified in other Sections.
18. Premanufactured guardrails.

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

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

C. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 04 22 00 "Concrete Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
3. Section 05 12 00 "Structural Steel Framing."

4. Section 32 93 00 “Exterior Plants” and 32 94 00 “Interior Plants” for tree grates.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

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

1.4 ACTION SUBMITTALS

A. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: For Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Corporate Sustainability Reporting (CSR’s)

B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for ceiling-hung toilet compartments.
2. Steel framing and supports for overhead doors and grilles.
3. Steel framing and supports for countertops.
4. Steel tube reinforcement for low partitions.
5. Steel framing and supports for mechanical and electrical equipment.
6. Steel framing and supports for applications where framing and supports are not specified in other Sections.
7. Elevator machine beams, hoist beams, and divider beams.
8. Steel shapes for supporting elevator door sills.
9. Shelf angles.
10. Metal ladders.
11. Ladder safety cages.
12. Metal pipe crossovers.
13. Elevator pit sump covers.
14. Miscellaneous steel trim including steel angle corner guards and loading-dock edge angles.
15. Metal bollards.
16. Wire rope.
17. Pipe guards.
18. Metal downspout boots.
19. Loose steel lintels.

C. Delegated-Design Submittal: For ladders and alternating tread devices, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.

C. Welding certificates.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

E. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

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

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a professional Licensed Structural Engineer who is legally qualified to practice in jurisdiction where Project is located to design ladders.

B. 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.

2.2 METALS

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

B. Sustainability Requirements

1. Recycled Content of Steel Products: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 35 percent.
   a. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.
2. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:
   a. Product specific declarations in accordance with ISO 1404
   b. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
   c. Industry Wide Product Specific Type III EPD Third Party Certification
3. Corporate Sustainability Report: Provide third-party verified Corporate Sustainability Report (CPD) including impacts of extraction operations and activities associated with the manufacturer’s product and product’s supply chain conforming the following:
   a. Global Reporting Initiative (GRI) Sustainability report
   b. Organization for Economic Co-operation and Development (OOECD) Guidelines for Multinational Enterprises.
   c. U.N. Global Compact: Communication of Progress
   d. ISO 26000: 2010 Guidance on Social Responsibility
   e. USGBC Approved Program: Other approved programs meeting the CSR criteria.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

E. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

F. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

G. Rolled-Stainless-Steel Floor Plate: ASTM A 793.

H. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

I. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

J. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

K. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.

L. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

M. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

N. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

O. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).

P. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

Q. Nickel Silver Extrusions: ASTM B 151/B 151M, Alloy UNS No. C74500.

R. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

E. 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.

F. 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/E 488M, conducted by a qualified independent testing agency.

G. 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.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting," Section 09 91 23 Interior Painting," and Section 09 96 00 "High-Performance Coatings."

B. 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.

C. Water-Based Primer: Emulsion type, anticorrosive primer for mildly corrosive environments that is resistant to flash rusting when applied to cleaned steel, complying with MPI#107 and compatible with topcoat.

D. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

1. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
2. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.

H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

I. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

J. Shim Pads: Multi-polymer plastic, non-stain shim pad. 1/8-inch thick. Siza as needed to provide separation from dissimilar metals.

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 unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

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 bolts, spaced not more than 6 inches from ends and 24 inches 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 larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize shelf angles located in exterior walls.

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, except for elevator pit ladders.
2. For elevator pit ladders, comply with ASME A17.1/CSA B44.

B. Steel Ladders:

1. Space siderails 18 inches apart unless otherwise indicated.
2. Siderails: Continuous, 1/2-by-2-1/2-inch steel flat bars, with eased edges.
3. Rungs: 3/4-inch-diameter steel bars.
4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
6. Galvanize exterior ladders, including brackets.

2.9 LADDER SAFETY CAGES

A. General:

1. Fabricate ladder safety cages to comply with ANSI A14.3. Assemble by welding or with stainless-steel fasteners.
2. Provide primary hoops at tops and bottoms of cages and spaced not more than 20 feet o.c. Provide secondary intermediate hoops spaced not more than 48 inches o.c. between primary hoops.
3. Fasten assembled safety cage to ladder rails and adjacent construction by welding or with stainless-steel fasteners unless otherwise indicated.

B. Steel Ladder Safety Cages:

1. Primary Hoops: 1/4-by-4-inch flat bar hoops.
2. Secondary Intermediate Hoops: 1/4-by-2-inch flat bar hoops.
3. Vertical Bars: 3/16-by-1-1/2-inch flat bars secured to each hoop.

4. Galvanize ladder safety cages, including brackets and fasteners for external locations.
5. Prime ladder safety cages, including brackets and fasteners for internal locations, with zinc-rich primer.

2.10 METAL SHIPS' LADDERS AND PIPE CROSSOVERS

A. Provide metal ships' ladders and pipe crossovers where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Treads shall be not less than 5 inches exclusive of nosing or less than 8-1/2 inches including the nosing, and riser height shall be not more than 9-1/2 inches.
2. Fabricate ships' ladders and pipe crossovers, including railings from steel.
3. Fabricate treads and platforms from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than 3/4 inch in least dimension.
4. Comply with applicable railing requirements in Section 05 52 13 "Pipe and Tube Railings."

B. Galvanize exterior steel ships' ladders and pipe crossovers, including treads, railings, brackets, and fasteners.

2.11 ELEVATOR PIT SUMP COVERS

A. Fabricate from welded or pressure-locked steel bar grating Limit openings in gratings to no more than 3/4 inch in least dimension.

B. Provide steel angle supports as indicated.

2.12 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize exterior miscellaneous steel trim.

2.13 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

1. Fill bollards with concrete as indicated in Section 03 30 00 "Cast-In-Place Concrete.
2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.

B. Prime bollards with zinc-rich primer.

2.14 PREMANUFACTURED GUARDRAILS

A. Provide premanufactured steel guardrail with welded connections and steel baseplate for connection to floor.

1. Approximate height: 15 inches.
2. Finish: Shop finish with manufacturers standard finish.
   a. Color: Safety Yellow.

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

1. FS Industries
2. Ideal Warehouse Innovations Inc.

~~2.14~~2.15 PIPE GUARDS

A. Fabricate pipe guards from 3/8-inch-thick by 12-inch-wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch clearance between pipe and pipe guard. Drill each end for two 3/4-inch anchor bolts.

B. Galvanize pipe guards indicated for external locations.

C. Prime pipe guards indicated for internal locations with zinc-rich primer.

~~2.15~~2.16 LOOSE BEARING AND LEVELING PLATES

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

B. Galvanize plates.

~~2.16~~2.17 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 unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

~~2.17~~2.18 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.

2.182.19 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.192.20 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with universal shop primer unless indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

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.

B. Anchor supports for operable partitions overhead doors and overhead grilles securely to, and rigidly brace from, building structure.

3.3 INSTALLING METAL BOLLARDS

A. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.4 INSTALLING WIRE ROPE

A. Install wire rope at locations indicated. Secure wire ropes to structure and tighten to remove slack.

3.5 INSTALLING PIPE GUARDS

A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers or where indicated. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch bolts at each pipe guard. Mount pipe guards with top edge 26 inches above driving surface.

3.6 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.7 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.

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

END OF SECTION 05 50 00

SECTION 05 51 13 - METAL PAN STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Railing gates at the level of exit discharge.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
2. Section 05 52 13 "Pipe and Tube Railings" for pipe and tube railings.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

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

C. Coordinate locations of hanger rods and struts with other work so that they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

D. Coordinate locations of stair bases with structural.

1.3 ACTION SUBMITTALS

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

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: For Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section ~~01 40 00 "Quality Requirements,"~~ 01 45 00 “Quality Control”, to design stairs.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

2.2 METALS

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

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

C. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404

2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

D. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

E. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

F. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

G. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25, unless another grade is required by design loads; exposed.

H. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 coating, structural steel, Grade 33, unless another grade is required by design loads.

2.3 ABRASIVE NOSINGS

A. Extruded Units: Aluminum units with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Nystrom, Inc.; Model STSB-N3E or a comparable product by one of the following:
   a. Amstep Products.
   b. Balco, Inc.
2. Provide ribbed units, with abrasive filler strips projecting 1/16 inch (1.5 mm) above aluminum extrusion.
3. Nosings: Square-back units, 3 inches (75 mm) wide, without lip.

B. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with manufacturer.

C. Apply bituminous paint to concealed surfaces of cast-metal units set into concrete.

2.4 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for stairs indicated to be galvanized.

D. Post-Installed Anchors: chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

E. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

F. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

2.5 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it. Refer to Sections 09 9113 "Exterior Painting" and Section 09 91 23 "Interior Painting" for additional requirements.

D. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

2.6 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.7 STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Commercial Class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel plates or channels.
   a. Provide closures for exposed ends of channel stringers.
2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.
5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.

1. Steel Sheet: Uncoated cold-rolled steel sheet.
2. Steel Sheet: Galvanized-steel sheet, where indicated.

3. Directly weld metal pans to stringers; locate welds on top of subtreads where they are concealed by concrete fill. Do not weld risers to stringers.

D. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

E. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

2.8 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

C. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

D. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLING METAL PAN STAIRS

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

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

G. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 "Cast-in-Place Concrete."

3.2 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

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

END OF SECTION 05 51 13

SECTION 05 51 16 - METAL FLOOR PLATE STAIRS

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 industrial-type, straight-run stairs with steel floor plate treads and railings attached to metal floor plate stairs.

B. Related Requirements:

1. Section 05 51 13 “Metal Pan Stairs” for concrete filled metal pan stairs and platform.
2. Section 05 52 13 "Pipe and Tube Railings" for pipe and tube railings.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

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

1.4 ACTION SUBMITTALS

A. Product Data: For metal floor plate stairs and the following:

1. Metal floor plate treads.
2. Paint products.
3. Grout.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section ~~01 40 00 "Quality Requirements,"~~01 45 00 “Quality Control”, to design stairs.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

2.2 METALS

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

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

E. Abrasive-Surface Floor Plate: Steel diamond plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.

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

a. Balco, Inc.
b. Grace Construction Products; W.R. Grace & Co. -- Conn.
c. IKG Industries, a division of Harsco Corporation.
d. SlipNOT Metal Safety Flooring; W.S. Molnar Company.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for exterior stairs.

D. Post-Installed Anchors: Chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.

2. Use connections that maintain structural value of joined pieces.
3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Form exposed work with accurate angles and surfaces and straight edges.

C. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 4 welds: good quality, uniform undressed weld with minimal splatter.

D. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.6 STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," industrial class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel tubes as indicated
   a. Provide closures for exposed ends of steel tube stringers.
2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements.
3. Weld stringers to headers; weld framing members to stringers and headers.

C. Metal Floor Plate Stairs: Form treads and platforms to configurations shown from rolled-steel floor diamond plate of thickness needed to comply with performance requirements, but not less than 3/16 inch or as indicated.

1. Form treads with integral nosing and back edge stiffener. Form risers of same material as treads.
2. Weld steel supporting brackets to stringers and weld treads to brackets.
3. Fabricate platforms with integral nosings matching treads and weld to platform framing.

2.7 STAIR RAILINGS

A. Comply with applicable requirements in Section 05 52 13 "Pipe and Tube Railings."

1. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
2. Connect posts to stair framing by direct welding unless otherwise indicated.
3. Perforated-Metal Infill: Perforated-metal panels edged with U-shaped channels made from metal sheet, of same metal as perforated metal, and not

less than 0.123 inch thick. Orient perforated metal with pattern as indicated on Drawings with vertical panel joints aligned with railing posts.

2.8 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonmetallic, nonshrink grout unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 ADJUSTING AND CLEANING

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

END OF SECTION 05 51 16

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel pipe railings.
2. Stainless-steel pipe railings.

B. Related Requirements:

1. Section 05 51 13 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.
2. Section 05 51 16 "Metal Floor Plate Stairs" for steel tube railings associated with metal pan stairs.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for 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.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

E. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a professional Licensed Structural Engineer who is legally qualified to practice in jurisdiction where Project is located to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..

b. Infill load and other loads need not be assumed to act concurrently.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F.

2.2 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.

1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 2-1/4-inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL AND IRON

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
   a. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
   b. Industry Wide Product Specific Type III EPD Third Party Certification

C. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

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.

2.4 STAINLESS STEEL

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Tubing: ASTM A 554, Grade MT 304.

C. Pipe: ASTM A 312/A 312M, Grade TP 304.

D. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.

E. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.5 FASTENERS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930

C. Industry Wide Product Specific Type III EPD Third Party Certification

D. General: Provide the following:

1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
3. Stainless-Steel Railings: Type 304 stainless-steel fasteners.

E. 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.

F. 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.

G. Post-Installed Anchors: chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.6 MISCELLANEOUS MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930

C. Industry Wide Product Specific Type III EPD Third Party Certification

D. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

1. For stainless-steel railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

E. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

F. Galvanizing Repair Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting".

G. Shop Primers: Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting".

H. Intermediate Coats and Topcoats: Provide products that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.7 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. Shop assemble railings 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 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 are exposed to weather in a manner that excludes 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. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form Changes in Direction as Follows:

1. By inserting prefabricated elbow fittings.

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 or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and 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 concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

P. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load,

measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

Q. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.8 STEEL AND IRON FINISHES

A. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

B. 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.

C. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in concrete or masonry.

D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with primers specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting" unless indicated.
2. Do not apply primer to galvanized surfaces.

2.9 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines, or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches.

C. Dull Satin Finish: No. 6.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 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 are 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.
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.

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

1. Concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals shall be separated with #30 building felt.

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.

3.3 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical 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 beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For stainless-steel pipe railings, weld flanges to post and bolt to supporting surfaces.
2. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.

B. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. 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 hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

3.6 ADJUSTING AND CLEANING

A. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

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

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

SECTION 05 53 13 - BAR GRATINGS

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 metal bar gratings and metal frames and supports for gratings.

B. Related Requirements:

1. Section 05 12 00 "Structural Steel Framing" for structural-steel framing system components.
2. Section 05 52 13 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.3 COORDINATION

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

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Clips and anchorage devices for gratings.

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

C. Delegated-Design Submittal: For gratings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

~~A. Mill Certificates: Signed by manufacturers of stainless steel certifying that products furnished comply with requirements.~~

~~B.~~A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 45 00 "Quality Control" to design gratings.

B. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

~~1. Extra Heavy-Duty Grates shall withstand H20 loadings.~~
~~2.~~1. Floors: Uniform load of 250 lbf/sq. ft. or concentrated load of 3000 lbf, whichever produces the greater stress.
~~3.~~2. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft.
~~4.~~3. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft.
~~5.~~4. Limit deflection to L/360 or 1/4 inch, whichever is less.

2.2 METAL BAR GRATINGS

A. Metal Bar Grating Standards: Comply with NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

B. Welded Steel Grating:

1. Bearing Bar Spacing: 1-3/16-inch o.c.
2. Bearing Bar Depth: As required to comply with structural performance requirements.
3. Bearing Bar Thickness: As required to comply with structural performance requirements but not less than ~~¼ inch~~ 3/16 inch.
4. Crossbar Spacing: 4 inches o.c.
5. Traffic Surface: Smooth.
6. Steel Finish: Hot-dip galvanized with a coating weight of not less than 1.8 oz./sq. ft. of coated surface.

2.3 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Bars for Bar Gratings: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

C. Wire Rod for Bar Grating Crossbars: ASTM A 510.

D. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30.

E. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33, with G90 coating.

F. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 240/A 240M, Type 316L.

G. Stainless-Steel Bars and Shapes: ASTM A 276, Type 316L.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening stainless steel.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563 and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts, and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 2.

D. 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.

E. Post-Installed Anchors: Torque-controlled expansion or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.6 FABRICATION

A. Shop Assembly: Fabricate grating sections in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form from materials of size, thickness, and shapes indicated, but not less than that needed to support indicated loads.

D. Fit exposed connections accurately together to form hairline joints.

E. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

F. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates to fit grating units and weld to units in shop unless otherwise indicated.
2. Toeplate Height: 4 inches unless otherwise indicated.

G. Removable Grating Sections: Fabricate with banding bars attached by welding to entire perimeter of each section. Include anchors and fasteners of type indicated or, if not indicated, as recommended by manufacturer for attaching to supports.

1. Provide no fewer than four weld lugs for each heavy-duty grating section, with each lug shop welded to two bearing bars.
2. Furnish galvanized malleable-iron flange clamp with galvanized bolt for securing grating to supports. Furnish as a system designed to be installed from above grating by one person.

H. Fabricate cutouts in grating sections for penetrations indicated. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

1. Edge-band openings in grating that interrupt four or more bearing bars with bars of same size and material as bearing bars.

I. Do not notch bearing bars at supports to maintain elevation.

2.7 GRATING FRAMES AND SUPPORTS

A. Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.
2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24 inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4 inch thick by 8 inches long.

B. Galvanize steel frames and supports.

2.8 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

2.9 SCAFFOLD DEBRIS NETTING

A. Scaffold Debris Netting: Flame-retardant, heavy duty HDPE monofilament material to prevent tools and materials from falling to lower levels.

1. Attachment Method: Manufacturer’s standard reinforced button holes or metal grommets.
2. Mesh Size: 3/8-inch maximum.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

3.2 INSTALLING METAL BAR GRATINGS

A. General: Install gratings to comply with recommendations of referenced metal bar grating standards that apply to grating types and bar sizes indicated, including installation clearances and standard anchoring details.

B. Attach removable units to supporting members with type and size of clips and fasteners indicated or, if not indicated, as recommended by grating manufacturer for type of installation conditions shown.

C. Attach nonremovable units to supporting members by welding where both materials are same; otherwise, fasten by bolting as indicated above.

3.3 ADJUSTING AND CLEANING

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

END OF SECTION 05 53 13

SECTION 05 53 16 - PLANK GRATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes formed-metal plank gratings and metal frames and supports for gratings.

B. Related Requirements:

1. Section 05 12 00 "Structural Steel Framing" for structural-steel framing system components.
2. Section 05 52 13 "Pipe and Tube Railings" for metal pipe and tube handrails and railings.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

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

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Formed-metal plank gratings.
2. Extruded-aluminum plank gratings.
3. Paint products.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Shop Drawings: Include plans, sections, details, and attachments to other work.

D. Delegated-Design Submittal: For gratings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by manufacturers of stainless-steel sheet certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 35 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

C. Delegated Design: Engage a qualified professional engineer, as defined in Section ~~01 40 00 "Quality Requirements,"~~ 01 45 00 “Quality Control”, to design gratings.

D. Structural Performance: Gratings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Floors: Uniform load of 125 lbf/sq. ft. or concentrated load of 2000 lbf, whichever produces the greater stress.
2. Floors: Uniform load of 250 lbf/sq. ft. or concentrated load of 3000 lbf, whichever produces the greater stress.
3. Walkways and Elevated Platforms Other Than Exits: Uniform load of 60 lbf/sq. ft..
4. Walkways and Elevated Platforms Used as Exits: Uniform load of 100 lbf/sq. ft..
5. Sidewalks and Vehicular Driveways, Subject to Trucking: Uniform load of 250 lbf/sq. ft. or concentrated load of 8000 lbf, whichever produces the greater stress.
6. Limit deflection to L/360 or 1/4 inch, whichever is less.

2.2 FORMED-METAL PLANK GRATINGS

A. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 35 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

C. C-shaped channels rolled from heavy sheet metal of thickness indicated, and punched in serrated diamond shape to produce raised slip-resistant surface and drainage holes.

1. Channel Width: As required to comply with structural performance requirements.
2. Channel Depth: As required to comply with structural performance requirements.
3. Material: 0.104-inch-thick steel sheet, hot-dip galvanized after fabrication.

2.3 FERROUS METALS

A. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 35 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Uncoated Steel Sheet: ASTM A 1011/A 1011M, structural steel, Grade 30.

E. Galvanized-Steel Sheet: ASTM A 653/A 653M, structural quality, Grade 33, with G90 coating.

2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 35 percent.

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Provide primers that comply with Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting".

2.6 FABRICATION

A. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Fit exposed connections accurately together to form hairline joints.

C. Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

D. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure gratings, frames, and supports rigidly in place and to support indicated loads.

1. Fabricate toeplates for attaching in the field.
2. Toeplate Height: 4 inches unless otherwise indicated.

E. Fabricate cutouts in grating sections for penetrations of sizes and at locations indicated. Cut openings neatly and accurately to size. Edge-band openings with metal sheet or bars having a thickness not less than grating material.

1. Arrange cutouts to permit grating removal without disturbing items penetrating gratings.

F. Where gratings are pierced by pipes, ducts, and structural members, cut openings neatly and accurately to size and weld a strap collar not less than 1/8-inch-thick to the cut ends. Divide panels into sections only to extent required for installation where grating platforms and runways are to be placed around previously installed pipe, ducts, and structural members.

2.7 GRATING FRAMES AND SUPPORTS

A. Frames and Supports: Fabricate from metal shapes, plates, and bars of welded construction to sizes, shapes, and profiles indicated and as necessary to receive gratings. Miter and weld connections for perimeter angle frames. Cut, drill, and tap units to receive hardware and similar items.

1. Unless otherwise indicated, fabricate from same basic metal as gratings.
2. Equip units indicated to be cast into concrete or built into masonry with integrally welded anchors. Unless otherwise indicated, space anchors 24

inches o.c. and provide minimum anchor units in the form of steel straps 1-1/4 inches wide by 1/4-inch-thick by 8 inches long.

B. Galvanize steel frames and supports in the following locations:

1. Exterior.
2. Interior, where indicated.

2.8 STEEL FINISHES

A. Finish gratings, frames, and supports after assembly.

B. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

D. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade the surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Attach toeplates to gratings by welding at locations indicated.

F. Field Welding: Comply with AWS recommendations and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.

G. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

3.2 INSTALLING METAL PLANK GRATINGS

A. General: Comply with manufacturer's written instructions for installing gratings. Use manufacturer's standard anchor clips and hold-down devices for bolted connections.

B. Attach removable units to supporting members by bolting at every point of contact.

C. Attach nonremovable units to supporting members by welding unless otherwise indicated. Comply with manufacturer's written instructions for size and spacing of welds.

D. Attach aluminum units to steel supporting members by bolting at side channels at every point of contact and by bolting intermediate planks at each end on alternate sides. Bolt adjacent planks together at midspan.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

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

END OF SECTION 05 53 16

SECTION 05 58 13 - COLUMN COVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal column covers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Paints and Coatings (applied on-site only)
   b. Low Emitting Materials for Adhesives and Sealants
3. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Shop Drawings: Show fabrication and installation details for column covers.

D. Coordination Drawings: Show all items to be enclosed within, attached to, and inserted into the column covers.

E. Samples for Initial Selection: For products involving selection of color, texture, or design.

F. Samples for Verification: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

1.3 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build in-place mockups of typical column covers as selected by the Architect.
2. Mock-up shall include all concealed utilities, equipment, etc. provided by others as well as access panels and grilles.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver column covers wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

PART 2 - PRODUCTS

2.1 COLUMN COVERS (MCC1)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Gordon, Inc.; eConnect Metal Column Covers or comparable product by one of the following manufacturers meeting all requirements including sustainability requirements.

1. BellPro Architectural, LLC.
2. C.R. Laurence Co., Inc.
3. Fry Reglet Architectural Metals

B. Materials:

1. Galvanized Steel Sheet: ~~14 gauge~~ 16 gauge.
   a. Finish: Custom Powder Coat
   b. Color: Match Benjamin Moore, Dove White (OC17)
   c. Smooth, High-Gloss
2. Top Cap: ASTM B 209 Aluminum, 5052-H34, 0.063” Thick (min)
   a. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

C. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 35 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

D. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

2.2 MISCELLANEOUS MATERIALS

A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting column covers and for attaching them to other work unless exposed fasteners are unavoidable or are the standard fastening method.
2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

B. Access Panels: Fabricated from the same basic metal, finish and color as the column cover.

1. Door Type: Flush with concealed flanges and concealed hinges.
2. Door Size and Location: As required to access interior equipment.
3. Latch and Lock: Cam latch, key operated with interior release.

C. Speaker Covers: Fabricated from acoustically transparent material.

1. Location: Coordinate location with speaker locations.

2.3 FABRICATION, GENERAL

A. Coordinate dimensions and attachment methods of column covers with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

B. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush, oil-can free surfaces without cracking or grain separation at bends.

2.4 GENERAL FINISH REQUIREMENTS

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

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

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. 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.

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 column covers.

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

3.2 INSTALLATION

A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Corrosion Protection: Apply #30 building felt between concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean 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. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
2. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

C. Cleaning: Refer to section 01 74 23 “Final Cleaning” for approved cleaning products.

3.4 PROTECTION

A. Protect finishes from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 05 58 13

SECTION 05 71 00 - DECORATIVE METAL STAIRS

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section includes steel-framed decorative metal stairs.

B. Related Requirements:

1. Section 03 45 00 “Precast Architectural Concrete” for precast concrete treads.
~~1.~~2. Section 05 73 13 “Glazed Decorative Metal Railings” for glazed decorative metal railings.
~~2.~~3. Section 09 66 23 "Resinous Matrix Terrazzo Flooring" for terrazzo treads and landings for decorative metal stairs.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

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

1.4 ACTION SUBMITTALS

A. Product Data: For metal stairs and the following:

1. Abrasive nosings.
2. Paint products.
3. Grout.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: For Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Corporate Sustainability Reporting (CSR’s)

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Shop drawings shall be sealed by a licensed professional engineer licensed in the state of Florida.

D. Structural Calculations:

1. Structural calculation to be sealed by a licensed professional engineer licensed in the State of Florida.

E. Samples for Initial Selection: For products involving selection of color, texture, or design.

F. Samples for Verification: For the following products:

1. Abrasive nosings, 12-inches long.

G. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Qualification Data: For qualified professional engineer.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For ornamental steel-framed stairs, materials and finishes to include in maintenance manuals as specified in Section 01 78 00 “Closeout Submittals”.

B. Warranties: 12-month warranty as specified in Section 01 78 00 “Closeout Submittals”.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Ornamental Stairs: Architectural class.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 45 00 “Quality Control, to design stairs.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

2.2 METALS

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

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

C. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

D. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

E. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.

F. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, structural steel, Grade 25, unless another grade is required by design loads; exposed.

G. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

H. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

2.3 ABRASIVE NOSINGS

A. Extruded Units: Stainless steel units, 2-inches wide, with abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Fabricate units in lengths necessary to accurately fit openings or conditions as indicated in Drawings.

1. Provide ribbed units, with abrasive filler strips projecting 1/16 inch above aluminum extrusion.

B. Provide anchors for embedding units in terrazzo, either integral or applied to units, as standard with manufacturer.

2.4 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

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

2.5 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Sections 09 91 13 “Exterior Painting” and 09 91 23 “Interior Painting”.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 PRECAST RESINOUS MATRIX TERRAZZO TREADS AND RISERS

A. Resinous Matrix Terrazzo: Refer to Section 09 66 23 "Resinous Matrix Terrazzo Flooring".

2.7 RESINOUS MATRIX TERRAZZO LANDINGS

A. Resinous Matrix Terrazzo: Refer to Section 09 66 23 "Resinous Matrix Terrazzo Flooring".

2.8 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

2.9 STEEL-FRAMED STAIRS

A. Stair Framing:

1. Fabricate stringers of steel sections as indicated.
2. Construct platforms of steel tube headers and miscellaneous framing members as needed to comply with performance requirements.
3. Weld stringers to headers; weld framing members to stringers and headers.

B. Subtreads, Risers, and Subplatforms:

1. Form subtreads, risers, and subplatforms to configurations indicated from cold-rolled steel sheet 0.075 inch thick or of thickness indicated.
2. Weld substreads to stringers. Locate welds on top of subtreads where they will be concealed by finished treads.
3. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

C. Smooth Soffit Construction: Construct subplatforms with flat metal under surfaces to produce smooth soffits.

2.10 STAIR RAILINGS

A. Comply with applicable requirements in Section 05 73 13 "Glazed Decorative Metal Railings."

1. Connect railing to stair framing by direct welding unless otherwise indicated.

2.11 FINISHES

A. Finish metal stairs after assembly.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "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. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete or masonry.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

G. Install resinous matrix terrazzo treads with adhesive supplied by manufacturer.

END OF SECTION 05 71 00

SECTION 05 73 00 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Stainless-steel decorative railings with stainless-steel wire-rope guard infill.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood blocking for anchoring railings.
2. Section 09 22 16 "Non-Structural Metal Framing" for metal backing for anchoring railings.

1.2 DEFINITIONS

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

1.3 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

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 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 meet structural performance requirements.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content

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

D. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.

E. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Welded connections.

F. 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.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

C. Welding certificates.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

E. Preconstruction test reports.

F. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Refer to Section 01 43 39 “Visual Mock-Up Requirements” for additional requirements.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on laboratory mockups. Payment for these services will be made by Owner. Retesting of products that fail to meet specified requirements shall be done at Contractor's expense.

1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
2. Test railings according to ASTM E 894 and ASTM E 935.

3. Notify Architect seven days in advance of the dates and times when laboratory mockups will be tested.

1.9 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Stainless-Steel Decorative Railings:

B. 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. Architectural Metal Works.
2. Livers Bronze Co.
3. Peterson Metals
4. VIVA Railings, LLC.

C. Source Limitations: Obtain each type of railing from single source from single manufacturer.

D. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section ~~01 40 00 "Quality Requirements,"~~01 45 00 “Quality Control”, to design railings, including attachment to building construction.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Stainless Steel: 60 percent of minimum yield strength.

C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
   b. Infill load and other loads need not be assumed to act concurrently.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.3 METALS, GENERAL

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

B. End (termination) posts: 2” square tube x ¼” wall, type 304 stainless steel, #4 finish.

C. Line posts: 1”x2” rectangle tube x 11ga. wall, type 304 stainless steel, #4 finish.

D. Top rail: 1”x3” rectangle tube x 11ga. wall, type 304 stainless steel, #4 finish.

E. Infill: Ø3/16 cable, 1:19 strand, left hand lay, type 316 stainless steel, #4 finish.

F. Fittings: Receiver and swage stud system, type 316 stainless steel, #4 finish.

G. Handrail: Ø1-1/2” round tube x 11ga. wall, type 304 stainless steel, #4 finish.

H. Handrail bracket: Ø5/8” round rod, type 304 stainless steel, #4 finish.

2.4 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304.

B. Pipe: ASTM A 312/A 312M, Grade TP 304.

C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.

D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 304.

E. Bars and Shapes: ASTM A 276, Type 304.

F. Wire Rope and Fittings:

1. Wire Rope: 1-by-19 wire rope made from wire complying with ASTM A 492, Type 316.

2. Wire-Rope Fittings: Connectors of types indicated, fabricated from stainless steel, and with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

2.5 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Stainless-Steel Components: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.

1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.6 MISCELLANEOUS MATERIALS

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

B. Shop Applied Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

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

2.7 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. Make up wire-rope assemblies in the shop to field-measured dimensions with fittings machine swaged. Minimize amount of turnbuckle take-up used for dimensional adjustment so maximum amount is available for tensioning wire ropes. Tag wire-rope assemblies and fittings to identify installation locations and orientations for coordinated installation.

D. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

E. Form work true to line and level with accurate angles and surfaces.

F. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

G. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

H. Connections: Fabricate railings with welded connections unless otherwise indicated.

I. 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 welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds; no evidence of a welded joint.

J. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

K. Form changes in direction as follows:

1. As detailed.

L. 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.

M. Close exposed ends of hollow railing members with prefabricated end fittings.

N. 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 or less.

O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

P. 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.

2.8 GENERAL FINISH REQUIREMENTS

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

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.9 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.

C. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 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.
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.

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

D. 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.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ATTACHING RAILINGS

A. Anchor railing ends to concrete and masonry with flanges connected to railing ends and anchored to wall construction with anchors and bolts.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.

C. Attach handrails to walls with wall brackets. Provide brackets with 2-1/4-inch 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.

D. 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 hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.
4. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements using self-tapping screws of size and type required to support structural loads.
5. For steel-framed partitions, fasten brackets with toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING

A. Refer to Section 01 35 46 “Indoor Air Quality” and Section 01 74 23 “Final Cleaning” for additional requirements.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 73 00

SECTION 05 73 10 - SMOKE BAFFLE SYSTEM

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Pre-engineered, component-based, smoke baffle system.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood blocking for anchoring railings.

1.3 REFERENCES

A. ANSI Z97.1 - Safety Glazing Material Used in Buildings.

B. ASTM E 985 – Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data, including description of materials, components, fabrication, finishes and installation instructions. Installation instructions include all structural computations and test reports provided by the manufacturer evidencing compliance with the specifications.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content

C. Shop Drawings: Submit manufacturer's shop drawings, including plans, elevations, sections, and details, indicating materials, components, sizes, dimensions, tolerances, hardware, fasteners, finishes, options, accessories, and installation. Show details of attachment of smoke baffle system to supports.

D. Submit manufacturer's samples of standard materials, finishes, colors, and textures.

E. Manufacturer's Quality Assurance: Submit manufacturer's certification that materials comply with specified requirements and are suitable for intended application. Submit certification that the manufacturer has not less than 5 years’ experience producing the product specified in this section. Installation of this product will be done by the manufacturer or an approved installer.

F. Maintenance Instructions: Submit manufacturer's maintenance and cleaning instructions.

G. Warranty: Submit manufacturer's standard warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Storage: Store materials in clean, dry area indoors in accordance with manufacturer's instructions.

C. Handling: Protect materials and finish from damage during handling and installation.

PART 2 - PRODUCTS

2.1 SMOKE BAFFLE SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide Smoke Baffle Systems by Blumcraft a division of C.R. Lawrence Co. Inc. or comparable product by one of the following:
   1. Livers Bronze
   2. VIVA Railings

B. Pre-Engineered, Component-Based, Smoke Baffle System
   1. Base 1-17/32” (38.9 mm) x 2-51/64” (71 mm) extruded aluminum - for 1/2” (12 mm) Tempered Glass.
   2. Glazing Material: ANSI Z97.1.
      a. Field glaze glass panels.
      b. Tempered Glass: Kind FT (fully tempered).
      c. Thickness: ½-inch.
   3. Finish
      a. Powder Coat: Color as selected by the Architect from Manufacturer’s full range.

C. Recycled Content of Aluminum Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
   1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive smoke baffle system. Notify Architect if areas are not acceptable. Do not begin installation until unacceptable conditions have been corrected.

3.2 INSTALLATION

A. Install smoke baffle system in accordance with manufacturer's instructions using trained installers.

B. Install units rigid, straight, level, and plumb.

C. Attach smoke baffle system securely in place using fasteners supplied or approved by manufacturer. All embedded anchor plates and supporting steel shall be provided by another trade and coordinated with the smoke baffle supplier.

D. Attach smoke baffle system to supports as indicated on the drawings and as approved by manufacturer.

E. Use manufacturer's supplied hardware.

F. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by Architect.

G. Remove and replace defective or damaged components that cannot be successfully repaired as determined by Architect.

3.3 CLEANING

A. Clean smoke baffle system promptly after installation in accordance with manufacturer's instructions.

B. Do not use harsh or abrasive cleaning materials or methods that would damage glass or finish.

C. Refer to Section 01 74 23 “Final Cleaning” for additional cleaning requirements.

3.4 PROTECTION

A. Protect installed smoke baffle system from damage during other construction.

END OF SECTION 05 73 10

SECTION 05 73 13 - GLAZED DECORATIVE METAL 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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Glass-supported railings.

1.3 DEFINITIONS

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

1.4 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.

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 items to Project site in time for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
2. Grout, anchoring cement, and paint products.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Adhesives and Sealants
3. Product Certificates: Provide the following:
   a. Health Product Declarations (HPD’s)

b. Corporate Sustainability Reporting (CSR's)

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

D. Samples for Verification: For each type of exposed finish required.

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.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

D. Preconstruction test reports.

E. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.8 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Refer to Section 01 43 39 "Visual Mock-Up Requirements" for additional requirements.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Architectural Metal Works.
2. Blum, Julius & Co., Inc.
3. Laurence, C. R. Co., Inc.
4. Livers Bronze Co.
5. VIVA Railings, LLC.

B. Source Limitations: Obtain each type of railing from single source from single manufacturer.

C. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods, including structural analysis, preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of railings and are based on the specific system indicated. See Section 01 60 00 "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a professional Licensed Structural Engineer who is legally qualified to practice in jurisdiction where Project is located to design railings, including attachment to building construction.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
2. Copper Alloys: 60 percent of minimum yield strength.
3. Stainless Steel: 60 percent of minimum yield strength.
4. Steel: 72 percent of minimum yield strength.
5. Glass: 25 percent of mean modulus of rupture (50 percent probability of breakage), as listed in "Mechanical Properties" in AAMA's Aluminum Curtain Wall Series No. 12, "Structural Properties of Glass."

C. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Infill of Guards:
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
   b. Infill load and other loads need not be assumed to act concurrently.

3. Glass-Supported Railings: Support each section of top rail by a minimum of three glass panels or by other means so top rail will remain in place if any one panel fails.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.3 METALS, GENERAL

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

B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.4 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade MT 304.

B. Pipe: ASTM A 312/A 312M, Grade TP 304.

C. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.

D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666 or ASTM A 240/A 240M, Type 304.

E. Bars and Shapes: ASTM A 276, Type 304.

2.5 STEEL AND IRON

A. Tubing: ASTM A 500/A 500M (cold formed) or ASTM A 513.

B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.

2.6 GLASS AND GLAZING MATERIALS

A. Tempered Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated), Type 1 (transparent flat glass), Quality-Q3. Provide products that have been tested for surface and edge compression according to ASTM C 1048 and for impact strength according to 16 CFR 1201 for Category II materials.

1. Basis of Design: PPG Starphire or comparable product meeting all requirements including sustainability requirements by one of the following manufacturers
   a. Guardian Glass, LLC
   b. Pilkington North America.
2. Glass Color: Ultraclear.
3. Thickness: As required by structural loads, but not less than 12.0 mm.

B. Laminated Glass: ASTM C 1172, Condition A (uncoated), Type I (transparent flat glass), Quality-Q3 with two plies of glass and polyvinyl butyral interlayer not less than 0.060 inch thick.

1. Basis of Design: PPG Starphire or comparable product meeting all requirements including sustainability requirements by one of the following manufacturers
   a. Guardian Glass, LLC
   b. Pilkington North America.
2. Kind: LT (laminated tempered).
3. Glass Color: Ultraclear.
4. High Strength Interlayer:
   a. Basis of Design: DuPont™ SentryGlas® Plus, as manufactured by DuPont™ Building Innovations™; 4417 Lancaster Pike, Chestnut Run Plaza 728, Wilmington, DE 19805; www.DuPont.com/safetyglass
   b. Thickness: 0.060 inch
   c. Color: Clear
   d. Interlayer Physical Properties:
      1) Young's Modulus: 43 kpsi, when tested in accordance with ASTM D5026
      2) Tensile Strength: 5.0 kpsi, when tested in accordance with ASTM D638.
      3) Elongation: 400%, when tested in accordance with ASTM D638
      4) Flex Modulus: 50 kpsi, when tested in accordance with D790.
      5) Heat Deflection Temperature at 0.46 MPa: 110 deg F, when tested in accordance with D648.
5. Glass Plies: Thickness required by structural loads, but not less than 6.0 mm thick, each.

C. Glazing Cement and Accessories for Structural Glazing: Glazing cement, setting blocks, shims, and related accessories as recommended or supplied by railing manufacturer for installing structural glazing in metal subrails.

1. Glazing Cement: Nonshrinking organic cement designed for curing by passing an electric current through metal subrail holding glass panel, as standard with manufacturer.

D. Glazing Gaskets for Glass Infill Panels: Glazing gaskets and related accessories recommended or supplied by railing manufacturer for installing glass infill panels in post-supported railings.

2.7 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Stainless-Steel Components: Type 304 stainless-steel fasteners.
2. Dissimilar Metals: Type 304 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.

1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.8 MISCELLANEOUS MATERIALS

A. Shop Applied Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

C. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

2.9 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 unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

H. Form changes in direction as follows:

1. As detailed.

I. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of hollow railing members with prefabricated end fittings.

K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work where indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.

L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

2.10 GLAZING PANEL FABRICATION

A. General: Fabricate to sizes and shapes required; provide for proper edge clearance and bite on glazing panels.

1. Clean-cut or flat-grind edges at butt-glazed sealant joints to produce square edges with slight chamfers at junctions of edges and faces.
2. Grind smooth exposed edges, including those at open joints, to produce square edges with slight chamfers at junctions of edges and faces.

B. Structural Balusters: Provide laminated, tempered glass panels.

2.11 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.12 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Directional Satin Finish: No. 4.

C. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

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.
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.

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

D. 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. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.3 INSTALLING GLASS PANELS

A. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.

1. Attach base channel to building structure, then insert and connect factory-fabricated glass panels.
2. Adjust spacing of glass panels so gaps between panels are equal before securing in position.
3. Erect glass railings under direct supervision of manufacturer's authorized technical personnel.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner.

B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings according to ASTM E 894 and ASTM E 935 for compliance with performance requirements.

C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.

D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.5 CLEANING

A. Clean aluminum and stainless steel by washing thoroughly with water and soap, rinsing with clean water, and wiping dry.

B. Clean and polish glass as recommended in writing by manufacturer. Wash both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion.

C. Refer to Section 01 35 46 “Indoor Air Quality” and Section 01 74 23 “Final Cleaning” for additional requirements.

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.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 73 13

SECTION 05 75 00 - DECORATIVE FORMED METAL

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed metal trim.
2. Metal base.
3. Overhead clearance bars

1.3 COORDINATION

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

B. Coordinate installation of decorative formed metal with adjacent construction to ensure that wall assemblies, flashings, trim, and joint sealants, are protected against damage from the effects of weather, age, corrosion, and other causes of deterioration.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Sustainable Design Submittals:

1. Product Data: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C” for Leadership Extraction Practices for the following:
   a. Extended Producer Responsibility
   b. Recycled content
2. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Adhesives and Sealants
3. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Shop Drawings: Show fabrication and installation details for decorative formed metal.

1. Include plans, elevations, component details, and attachment details.

2. Indicate materials and profiles of each decorative formed metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.

D. Samples for Initial Selection: For products involving selection of color, texture, or design.

E. Samples for Verification: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For decorative formed metal elements that house items specified in other Sections. Show dimensions of housed items, including locations of housing penetrations and attachments, and necessary clearances.

B. Qualification Data: For Installer.

C. Mill Certificates: Signed by stainless-steel manufacturers certifying that products furnished comply with requirements.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Refer to Section 01 43 39 “Visual Mock-Up Requirements” for additional requirements.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver decorative formed metal products wrapped in protective coverings and strapped together in suitable packs or in heavy-duty cartons. Remove protective coverings before they stain or bond to finished surfaces.

B. Store products on elevated platforms in a dry location.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, beams, and other construction contiguous with decorative formed metal by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 SHEET METAL

A. General: Fabricate products from sheet metal without pitting, seam marks, roller marks, stains, discolorations, or other imperfections where exposed to view on finished units.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.2 MISCELLANEOUS MATERIALS

A. Sealants, Interior: Nonsag, paintable sealant complying with Section 07 92 00 "Joint Sealants" and as recommended in writing by decorative formed metal manufacturer.

B. Filler Metal and Electrodes: Provide type and alloy of filler metal and electrodes as recommended by producer of metal to be welded or brazed and as necessary for strength, corrosion resistance, and compatibility in fabricated items.

1. Use filler metals that will match the color of metal being joined and will not cause discoloration.

C. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide concealed fasteners for interconnecting decorative formed metal items and for attaching them to other work unless exposed fasteners are unavoidable or are the standard fastening method.
2. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Nonstructural Anchors: For applications not indicated to comply with design loads, provide fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.

E. Anchor Materials:

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

F. Backing Materials: Provided or recommended by decorative formed metal manufacturer.

G. Laminating Adhesive: Adhesive recommended by metal fabricator that will fully bond metal to metal, will prevent telegraphing and oil-canning, and is compatible with substrate and noncombustible after curing.

1. Field applied adhesives shall comply with low emitting adhesives requirements:

a. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
b. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble decorative formed metal items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Coordinate dimensions and attachment methods of decorative formed metal items with those of adjoining construction to produce integrated assemblies with closely fitting joints and with edges and surfaces aligned unless otherwise indicated.

C. Form metal to profiles indicated, in maximum lengths to minimize joints. Produce flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch-wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.

D. Increase metal thickness or reinforce with concealed stiffeners, backing materials, or both, as needed to provide surface flatness equivalent to stretcher-leveled standard of flatness and sufficient strength for indicated use.

1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.

E. Build in straps, plates, and brackets as needed to support and anchor fabricated items to adjoining construction. Reinforce decorative formed metal items as needed to attach and support other construction.

F. Provide support framing, mounting and attachment clips, splice sleeves, fasteners, and accessories needed to install decorative formed metal items.

G. Where welding or brazing is indicated, weld or braze joints and seams continuously. Grind, fill, and dress to produce smooth, flush, exposed surfaces in which joints are not visible after finishing is completed.

1. Use welding and brazing procedures that will blend with and not cause discoloration of metal being joined.

2.4 DECORATIVE FORMED METAL FABRICATIONS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Decorative Formed Metal Type DM1, Type DM2, and Type DM3 as indicated in Section 09 00 01 “Finish Key” or comparable approved product meeting all requirements including sustainability requirements.

1. Refer to Sections 01 2500 “Substitution Procedures” and 01 6000 “Product Requirements” for comparable product requirements.

B. Form from metal of type and thickness indicated. Fabricate to fit tightly to adjoining construction.

C. Conceal fasteners where possible; otherwise, locate where they are as inconspicuous as possible. Size fasteners to support closures and trim, with fasteners spaced to prevent buckling or waviness in finished surfaces.

D. Drill and tap holes needed for securing closures and trim to other surfaces.

E. Incorporate gaskets where indicated or needed for concealed, continuous seal at abutting surfaces.

F. Miter or cope trim members at corners and reinforce with bent metal splice plates to form tight joints.

2.5 GENERAL FINISH REQUIREMENTS

A. Complete mechanical finishes of flat sheet metal surfaces before fabrication where possible. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match sheet finish.

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

C. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.

D. Finish items indicated on Drawings after assembly.

E. 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.

2.6 OVERHEAD CLEARANCE BEAMS

A. Basis-of-Design: Signal-Tech “I-Bar” or subject to compliance with criteria, comparable product.

B. Construction: Single-piece extruded aluminum bar with end caps and adjustable eyebolts for top mounting.

1. Size: 7 inches high by 4 inches deep by lengths shown on Drawings.
2. Finish: Manufacturer’s standard powder coat finish.
3. Color: Traffic Yellow.
4. Graphics: Vinyl letters and warning striping, color black.

2.7 CEILING DEVICE SLOT

A. Form ceiling device slots from metal of type and thickness indicated below. Coordinate size of slots, location of cutouts for electrical, mechanical, and fire protection and method of attachment to adjoining construction.

1. Aluminum Sheet: 0.063 inch (1.60 mm).
   a. Finish: Baked enamel or powder coat.
2. Fabricate light coves with hairline butt joints.
3. Provide factory endcaps.
4. Ceiling device slots may be fabricated from prefinished metal sheet in lieu of finishing after fabrication provided unfinished edges are concealed from view.

2.8 WIRE MESH INFILL PANELS

A. Woven-Wire Mesh: Intermediate-crimp, square pattern, 1-inch woven-wire mesh, made from 0.120-inch nominal diameter (minimum) stainless steel wire complying with ASTM A 580/A 580M, Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative formed metal.

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

3.2 INSTALLATION

A. Locate and place decorative formed metal items level and plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install decorative formed metal.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where needed to protect metal surfaces and to make a weathertight connection.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Install concealed gaskets, joint fillers, insulation, sealants, and flashings, as the Work progresses, to make exterior decorative formed metal items weatherproof.

E. Install concealed gaskets, joint fillers, sealants, and insulation, as the Work progresses, to make interior decorative formed metal items soundproof or lightproof as applicable to type of fabrication indicated.

F. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

3.3 ADJUSTING AND CLEANING

A. Unless otherwise indicated, clean metals by washing thoroughly with water and soap, rinsing with clean water, and drying with soft cloths. Refer to Section 01 74 23 “Final Cleaning” for additional requirements.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

3.4 PROTECTION

A. Protect finishes of decorative formed metal items from damage during construction period. Remove temporary protective coverings at time of Substantial Completion.

END OF SECTION 05 75 00

SECTION 06 10 00 - ROUGH CARPENTRY

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood blocking, cants, and nailers.
2. Plywood backing panels.

B. Related Sections

1. Section 07 13 26 “Self-Adhering Sheet Waterproofing” for separator between wood blocking and roof deck, cold-formed metal framing, aluminum flashing, and other metal components.

1.3 DEFINITIONS

A. Boards or Strips: Lumber of less than 2-inches nominal size in least dimension.

B. Dimension Lumber: Lumber of 2-inches nominal size or greater but less than 5-inches nominal size in least dimension.

C. OSB: Oriented strand board.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Testing Data:
   a. Documentation on Low Emitting Composite Wood Materials.
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all rough carpentry unless otherwise indicated.

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.
2. Roof construction.
3. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Grounds.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:

1. Mixed southern pine or southern pine; SPIB.
2. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

C. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 PLYWOOD BACKING PANELS

A. MANUFACTURERS

1. Boise Cascade
2. Certified Wood Products, Inc.
3. Dixie Plywood and Lumber Co.
4. Timber Products Co.

B. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

C. Low Emitting Materials: Comply with the requirements of the California Air Resources Board (CARB), Airborne Toxic Measure ATCM requirements for ultra-low emitting formaldehyde (ULEF) resins or no added formaldehyde resins. Refer to Section 01 81 13.14 “SUSTAINABLE DESIGN REQUIREMENTS - LEED V4 BD+C” for additional requirements

2.6 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

~~2.7 ACCESSORY MATERIALS~~

~~A. High temperature self-adhering membrane separator between wood blocking and metal components.~~

~~1. Refer to Section 07 13 26 "Self-Adhering Sheet Waterproofing".~~

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

D. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.

E. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

G. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 230 4.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

I. Install high temperature self-adhering membrane between pressure-treated wood blocking and metal components and in locations indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 FIELD QUALITY CONTROL

A. Architectural precast concrete installer shall provide field quality control by PCI certified staff and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

SECTION 06 16 00 - SHEATHING

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Parapet sheathing.
3. Roof Sheathing.
4. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for plywood backing panels.
2. Section 07 27 29 “Air-Barrier Coatings" for water-resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

A. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: For Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Corporate Sustainability Reporting (CSR’s)
   c. Health Product Declarations (HPD’s)
3. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Adhesives and Sealants

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 Sheathing, general

A. Recycled Content of Gypsum Based Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Health Product Declaration: Provide Health Product Declaration (HPD) with full disclosure of known hazards in compliance with the Health Product Declaration Open Standard

C. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

D. Corporate Sustainability Report: Provide third-party verified Corporate Sustainability Report (CPD) including impacts of extraction operations and activities associated with the manufacturer’s product and product’s supply chain conforming the following:

1. Global Reporting Initiative (GRI) Sustainability report
2. Organization for Economic Co-operation and Development (OOECD) Guidelines for Multinational Enterprises.
3. U.N. Global Compact: Communication of Progress
4. ISO 26000: 2010 Guidance on Social Responsibility
5. USGBC Approved Program: Other approved programs meeting the CSR criteria.

2.3 WALL SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Georgia-Pacific Building Products; Dens-Glass Gold.
   b. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
   c. United States Gypsum Company; Securock.
2. Type and Thickness: Type X, 5/8 inch thick.

3. Size: 48 by 96 inches for vertical installation.

B. Cementitious Backer Units: ASTM C1325, Type A.

1. Thickness: 5/8 inch.

2.4 ROOF AND PARAPET SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Georgia-Pacific Building Products; DensDeck Prime Roof Board.
   b. National Gypsum Company; DEXcell Cement Roof Board.
   c. United States Gypsum Company; Securock Glass-Mat Roof Board.
2. Type and Thickness: Type X, 5/8 inch thick.
3. Size: 48 by 96 inches for vertical installation.

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.

1. For steel framing less than 0.0329-inch-thick, use screws that comply with ASTM C 1002.
2. For steel framing from 0.033 to 0.112-inch-thick, use screws that comply with ASTM C 954.

2.6 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Refer to Section 07 27 29 “Air-Barrier Coatings” for joint treatment materials.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in the ICC's Florida Building Code Fifth Edition – Building.

D. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
4. Exposure after installation shall be determined by GA-253 or by Manufacturer’s written instructions.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

D. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.

3.3 FIELD QUALITY CONTROL

A. Installer shall provide field quality control by staff having adequate prior experience and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

END OF SECTION 06 16 00

SECTION 06 42 16 - FLUSH WOOD PANELING

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Flush wood paneling.
2. Wood furring, blocking, shims, and hanging strips for installing flush wood paneling that is not concealed within other construction.
3. Shop finishing of flush wood paneling.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing paneling that is concealed within other construction before paneling installation.

1.3 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that paneling can be installed as indicated.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
   b. Leadership Extraction Practices for Forrest Certified Wood
2. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Adhesives and Sealants
   b. Low Emitting Materials for Composite Wood
3. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Corporate Sustainability Reporting (CSR’s)
   c. Health Product Declarations (HPD’s)

B. Shop Drawings: For flush wood paneling.

1. Include plans, elevations, sections, and attachment details.
2. Show details full size.
3. Show locations and sizes of furring and blocking, including concealed blocking specified in other Sections.
4. For paneling produced from premanufactured sets, show finished panel sizes, set numbers, sequence numbers within sets, and method of cutting panels to produce indicated sizes.
5. For paneling veneered in fabrication shop, show veneer leaves with dimensions, grain direction, exposed face, and identification numbers indicating the flitch and sequence within the flitch for each leaf.
6. Apply AWI Quality Certification Program label to Shop Drawings.

C. Samples: For each exposed product and for each color and finish specified, in manufacturer's or fabricator's standard size.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For the following:

1. Veneer-Faced Panel Products for Transparent Finish: 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish as specified.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of product.

C. Quality Standard Compliance Certificates: AWI Quality Certification Program.

D. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1. Shop Certification: AWI's Quality Certification Program accredited participant.

B. Installer Qualifications: Fabricator of products.

C. Mockups: Build mockups as indicated in Section 01 43 39 “Visual Mock-up Requirements”.

1. Build mockups of typical paneling as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver paneling until painting and similar operations that might damage paneling have been completed in installation areas. Store paneling in installation

areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet-work is complete, and HVAC system is operating and will maintain temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.

B. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed/concealed by construction and indicate measurements on Shop Drawings.

C. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PANELING FABRICATORS

A. Source Limitations: Engage an FSC certified woodworking firm to assume undivided responsibility for production of paneling.

2.2 PANELING, GENERAL

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of flush wood paneling (wood-veneer wall surfacing) indicated for construction, finishes, installation, and other requirements.

1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.
2. The Contract Documents contain requirements that are more stringent than the referenced woodwork quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

B. FSC-Certified Products: For each product, provide FSC Chain of Custody certificate number (e.g. XXX-COC-######) from the supplier or manufacturer. FSC-certified products must be sourced from a FSC-certified supplier or manufacturer.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements

2.3 FLUSH WOOD PANELING (WD2)

A. Grade: Premium.

B. Wood Species and Cut: Refer to Section 09 00 01 “Finish Key”.

C. Veneer Matching Method: Refer to Section 09 00 01 “Finish Key”.

D. Panel-Matching Method: Refer to Section 09 00 01 “Finish Key”.

E. Vertical Panel-Matching Method: Refer to Section 09 00 01 “Finish Key”.

F. Panel Core Construction: Medium Density Fiberboard (MDF).

1. Low Emitting Composite Wood
   a. Provide composite wood products that meet the California Air Resources Board (CARB), Airborne Toxic Measure ATCM requirements for ultra-low emitting formaldehyde (ULEF) resins or no added formaldehyde resins.
   b. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.
2. Thickness: 3/4 inch unless noted otherwise.
3. Manufacturers: Subject to compliance with requirements, available manufacturers that may be incorporated into the Work include, but are not limited to the following:
   a. Georgia Pacific Wood Products, LLC.
   b. Roseburg.
   c. Columbia Forest Products.

G. Exposed Panel Edges: Inset solid-wood or wood-veneer matching faces.

H. Panel Reveals: Stainless-steel sheet.

I. Fire-Retardant-Treated Paneling: Panels shall consist of wood-veneer and fire-retardant particleboard or fire-retardant, medium-density fiberboard (MDF). Panels shall have a flame-spread index of 25 or less and a smoke-developed index of 450 or less per ASTM E 84, and be listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction.

J. Assemble panels by gluing and concealed fastening.

2.4 MATERIALS

A. Materials, General: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

B. Wood Moisture Content: 8 to 13 percent.

C. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each quality grade specified unless otherwise indicated.

1. Low Emitting Composite Materials – provide compliance with the California Air Resources Board (CARB), Airborne Toxic Measure ATCM requirements for ultra-low emitting formaldehyde (ULEF) resins or no added formaldehyde resins.

a. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

2. MDF: ANSI A208.2, Grade 130.

D. Low Emitting Adhesives and Sealants – provide compliance with California Department of Public Health (CDPH) Standard Method v1.1 2010.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

E. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

2.5 FIRE-RETARDANT-TREATED MATERIALS

A. Fire-Retardant-Treated Materials, General: Where fire-retardant-treated materials are indicated, use materials that are acceptable to authorities having jurisdiction and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

1. Use treated materials that comply with requirements of referenced quality standard. Do not use materials that are warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
3. Identify fire-retardant-treated materials with appropriate classification marking of qualified testing agency in the form of removable paper label or imprint on surfaces that will be concealed from view after installation.

B. Fire-Retardant Fiberboard: MDF panels complying with ANSI A208.2, made from softwood fibers, synthetic resins, and fire-retardant chemicals mixed together at time of panel manufacture to achieve flame-spread index of 25 or less and smoke-developed index of 200 or less per ASTM E 84.

2.6 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln-dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls.

C. Installation Adhesive: Product recommended by panel fabricator for each substrate for secure anchorage.

1. Adhesives shall have a VOC complying with the requirements of Section 01 81 13.14 “Sustainable Design Requirements – LEED v4 BD+C”.

2.7 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Arrange paneling in shop or other suitable space in proposed sequence for examination by Architect. Mark units with temporary sequence numbers to indicate position in proposed layout.

1. Lay out one elevation at a time if approved by Architect.
2. Notify Architect seven days in advance of the date and time when layout will be available for viewing.
3. Provide lighting of similar type and level as that of final installation for viewing layout unless otherwise approved by Architect.
4. Rearrange paneling as directed by Architect until layout is approved.
5. Do not trim end units and other nonmodular-size units to less than modular size until after Architect's approval of layout. Indicate trimming by masking edges of units with nonmarking material.
6. Obtain Architect's approval of layout before start of assembly. Mark units and Shop Drawings with assembly sequence numbers based on approved layout.

C. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify OAR and Architect seven days in advance of the dates and times paneling fabrication will be complete.

D. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.8 SHOP FINISHING

A. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.

C. Transparent Finish:

1. Grade: Same as item to be finished.
2. Finish: System - 1, nitrocellulose lacquer.
3. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
4. Staining: None required.
5. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
6. Sheen: As indicated in Section 09 00 01 “Finish Key”, gloss units measured on 60-degree gloss meter per ASTM D 523.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition paneling to humidity conditions in installation areas.

B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install paneling to comply with quality standard grade of paneling to be installed.

B. Install paneling level, plumb, true in line, and without distortion. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

C. Anchor paneling to supporting substrate as indicated in drawings.

D. Complete finishing work specified in this Section to extent not completed at shop or before installation of paneling. Fill nail holes with matching filler where exposed.

1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective paneling, where possible, to eliminate defects. Where not possible to repair, replace paneling. Adjust for uniform appearance.

B. Clean paneling on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

C. Refer to Section 01 74 23 “Final Cleaning” for additional requirements.

END OF SECTION 06 42 16

SECTION 06 64 00 - PLASTIC PANELING

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Glass fiber reinforced paneling

1.3 ACTION SUBMITTALS

A. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Adhesives and Sealants
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Corporate Sustainability Reporting (CSR’s)

B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

A. Testing Agency: Acceptable to authorities having jurisdiction.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING

A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Wall and Door Protection types as indicated in Section 09 00 01 “Finish Key” or comparable approved product meeting all requirements including sustainability requirements.
   a. Refer to Sections 01 2500 “Substitution Procedures” and 01 6000 “Product Requirements” for comparable product requirements.
2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.
3. Nominal Thickness: Not less than 0.09 inch.
4. Surface Finish: Molded pebble texture.
5. Color: As selected by Architect from manufacturer's full range.

B. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

C. Corporate Sustainability Report: Provide third-party verified Corporate Sustainability Report (CPD) including impacts of extraction operations and activities associated with the manufacturer’s product and product’s supply chain conforming the following:

1. Global Reporting Initiative (GRI) Sustainability report
2. Organization for Economic Co-operation and Development (OOECD) Guidelines for Multinational Enterprises.
3. U.N. Global Compact: Communication of Progress
4. ISO 26000: 2010 Guidance on Social Responsibility
5. USGBC Approved Program: Other approved programs meeting the CSR criteria.

2.3 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: As selected by Architect from manufacturer's full range.

B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive

1. Low Emitting Adhesives

a. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
b. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.

2. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
a. Henkel Corporation, OSI GreenSeries F-38 Drywall & Panel Construction Adhesive.
b. Red Devil, Inc., General Purpose Construction Adhesive
c. Titebond, Fast Set Polyurethane Construction Adhesive
d. Approved Substitution.

E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant complying with requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates 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 PREPARATION

A. Remove wallpaper, vinyl wall covering, lose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

1. Mark plumb lines on substrate at panel joint locations for accurate installation.
2. Locate panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.

1. Drill oversized fastener holes in panels and center fasteners in holes.
2. Apply sealant to fastener holes before installing fasteners.

D. Install factory-laminated panels using concealed mounting splines in panel joints.

E. Install trim accessories with adhesive and nails or staples. Do not fasten through panels.

F. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

I. Remove excess sealant and smears as paneling is installed. Clean with product as indicated in Section 01 74 23 “Final Cleaning”.

END OF SECTION 06 64 00

SECTION 07 13 26 - SELF-ADHERING SHEET 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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. The work of this section includes, but is not limited to, the following:

1. Pre-Applied sheet membrane waterproofing for horizontal applications prior to placement of poured concrete on top of the membrane, which forms and integral bond to poured concrete
2. Sheet membrane waterproofing system for post-applied applications onto vertical concrete walls
3. Prefabricated drainage and protection composite

B. Related Sections: Other specification sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 03 30 00 “Cast-In-Place Concrete” and 03 30 01 “Cast-In-Place Concrete – Parking Garage” for concrete reinforcing and formwork operations.
2. Section 03 13 15 “Waterstops”
3. Division 31 Sections for related earthwork.

1.3 REFERENCE STANDARDS

A. The following standards and publications are applicable to the extent referenced in the text.

B. American Society for Testing and Materials (ASTM)

1. C 836 Standard Specification for High Solids, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
2. D 412 Standard Test Methods for Rubber Properties in Tension
3. D 570 Standard Test Method for Water Absorption of Plastics
4. D 882 Standard Test Methods for Tensile Properties of Thin Plastic Sheeting
5. D 903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
6. D 1876 Standard Test Method for Peel Release of Adhesives (T-Peel)
7. D 1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
8. D 3767 Standard Practice for Rubber - Measurements of Dimensions
9. D 5385 Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
10. E 96 Standard Test Methods for Water Vapor Transmission of Materials
11. E 154 Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations.

B. Samples: Submit representative samples of the following for approval:

1. Pre-Applied sheet membrane waterproofing
2. Sheet membrane waterproofing system
3. Prefabricated drainage and protection composite

C. Shop Drawings showing waterproofing locations and typical details. Provide manufacturer approval.

D. Installer certification from waterproofing manufacture.

1.5 QUALITY ASSURANCE

A. Manufacturer: Sheet membrane waterproofing system shall be manufactured and marketed by a firm with a minimum of 20 years' experience in the production and sales of pre-applied membrane waterproofing and self-adhesive sheet membrane waterproofing. Manufacturers proposed for use but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past 5 years.

B. Installer: A firm which has at least 3 years' experience in work of the type required by this section and is approved by the waterproofing manufacturer to perform the work.

C. Materials: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer.

D. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.

E. Schedule Coordination: Schedule work such that membrane will not be left exposed to weather for longer than that recommended by the manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

1. Do not double-stack pallets of membrane on the job site. Provide cover on top and all sides, allowing for adequate ventilation.
2. Protect mastic and adhesive from moisture and potential sources of ignition.
3. Store drainage and protection composite flat and off the ground. Provide cover on top and all sides.
4. Protect surface conditioner from freezing.

B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.7 PROJECT CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.

B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

1.8 WARRANTY

A. Provide written watertight warranty from the manufacturer that includes both labor and material for the below grade walls and the under slab waterproofing. The warranty to be issued by the membrane manufacturer upon completion of the work.

1. Warranty Period: ~~Five~~ 10 years from date of Substantial Completion.
2. Refer to Section 03 13 15 “Waterstops” for additional warranty information.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pre-applied Integrally Bonded Sheet Waterproofing Membrane: Preprufe® 300R Membrane [or Preprufe 300LT Membrane for application temperatures between 25°F (-4°C) and 60°F (+16°C)] by GCP Applied Technologies, Inc., a 1.2mm (0.046 in) nominal thickness composite sheet membrane comprising 0.8 mm (0.030 in.) of high density polyethylene film, layers of specially formulated synthetic adhesive layers. The membrane shall form an integral and permanent bond to poured concrete to prevent water migration at the interface of the membrane and structural concrete. Provide membrane with the following physical properties:

Property	Test Method	Typical Value
Color		White
Thickness	ASTM D 3767 Method A	0.046 in. (1.2 mm) nominal
Lateral Water Migration Resistance	ASTM D 5385 Modified[1]	Pass at 231 ft (71m) of hydrostatic head pressure
Low Temperature Flexibility	ASTM D 1970	Unaffected at -20°F (-29°C)
Resistance to Hydrostatic Head	ASTM D 5385 Modified[2]	231 ft (71m)
Elongation	ASTM D 412 Modified[3]	500%
Tensile Strength, film	ASTM D 412	4,000 psi (27.6 MPa)
Crack Cycling at -9.4°F (-23°C), 100 Cycles	ASTM C 836	Unaffected, Pass
Puncture Resistance	ASTM E 154	221 lbs (990 N)

Peel Adhesion to Concrete	ASTM D 903 Modified[4]	5.0 lbs/in. (880 N/m)
Lap Peel Adhesion at 72°F (22°C)	ASTM D 1876 Modified[5]	8.0 lbs/in. (1408 N/m)
Lap Peel Adhesion at 40°F (4°C)	ASTM D 1876 Modified[5]	8.0 lbs/in. (1408 N/m)
Permeance to water vapor transmission	ASTM E 96 Method B	0.01 perms (0.6 ng/Pa x s x m^2)

1. Lateral water migration resistance is tested by casting concrete against membrane with a hole and subjecting the membrane to hydrostatic head pressure with water. The test measures the resistance of lateral water migration between the concrete and the blind side waterproofing membrane. A hydrostatic head pressure of 71 m (231 ft) of water is the limit of the apparatus.
2. Hydrostatic head tests are performed by casting concrete against the membrane with a lap. Before the concrete sets a 3 mm (0.125 in.) spacer is inserted perpendicular to the membrane to create a gap. The cured block is placed in a chamber where water is introduced to the membrane surface up to a head of 71 m (231 ft) of water which is the limit of the apparatus.
3. Elongation of membrane is run at a rate of 50 mm (2 in.) per minute.
4. Concrete is cast against the protective coating surface of the membrane and allowed to cure (7 days minimum). Peel adhesion of membrane to concrete is measured at a rate of 50 mm (2 in.) per minute at room temperature.
5. The test is conducted 15 minutes after the lap is formed as per manufacturer's instructions and run at a rate of 50 mm (2 in.) per minute at 72°F (22°C).
6. Refer to Sections 01 2500 "Substitution Procedures" and 01 6000 "Product Requirements" for comparable product requirements.

B. Sheet Membrane Waterproofing System: Bituthene® System 3000 Membrane by GCP Applied Technologies, Inc.; a self-adhesive, cold-applied composite sheet consisting of a thickness of 1.4 mm (0.056 in.) of rubberized asphalt and 0.1 mm (0.004 in.) of cross-laminated, high density polyethylene film specially formulated for use with water-based surface conditioner. Provide rubberized asphalt membrane covered with a release sheet which is removed during installation. No special adhesive or heat shall be required to form laps.

Property	Test Method	Typical Value
Color		Dark gray-black
Thickness	ASTM D 3767 Method A	1.5 mm (0.060 in.) nominal
Flexibility, 180° bend over 25 mm (1 in.) mandrel at -25°C (-32°F)	ASTM D 1970	Unaffected
Tensile Strength, Membrane Die C	ASTM D 412 Modified[1]	2240 kPa (325 lbs/in.^{2}) minimum
Tensile Strength, Film	ASTM D 882 Modified[1]	34.5 MPa (5,000 lbs/in.^{2}) minimum
Elongation, Ultimate Failure of Rubberized Asphalt	ASTM D 412 Modified[1]	300% minimum
Crack Cycling at -32°C (-25°F), 100 Cycles	ASTM C 836	Unaffected

Lap Adhesion at Minimum Application Temperature	ASTM D 1876 Modified[2]	800 N/m (4 lbs/in.)
Peel Strength	ASTM D 903 Modified[3]	1576 N/m (9 lbs/in.)
Puncture Resistance, Membrane	ASTM E 154	222 N (50 lbs) minimum
Resistance to Hydrostatic Head	ASTM D 5385	60 m (200 ft) of water
Permeance	ASTM E 96, Section 12 – Water Method	2.9 ng/m^{2}sPa (0.05 perms) maximum
Water Absorption	ASTM D 570	0.1% maximum

1. The test is run at a rate of 50 mm (2 in.) per minute.
2. The test is conducted 15 minutes after the lap is formed and run at a rate of 50 mm (2 in.) per minute at -4°C (25°F).
3. The 180° peel strength is run at a rate of 300 mm (12 in.) per minute.
4. Refer to Sections 01 2500 “Substitution Procedures” and 01 6000 “Product Requirements” for comparable product requirements.

C. Preformed Inside and Outside Corners: Preprufe Preformed Corners by GCP Applied Technologies, Inc. as prefabricated inside and outside corners.

D. Tape for covering cut edges, roll ends, penetrations and detailing: Preprufe Tape LT (for temperatures between 25°F (-4°C) and 86°F (30°C)) and Preprufe Tape HC (for use in Hot Climates, minimum 50°F (10°C))

E. Tape to be located under all construction joints in the concrete on top of the pre-applied sheet waterproofing membrane: Preprufe CJ Tape LT (for temperatures between 25°F (-4°C) and 86°F (30°C)) and Preprufe CJ Tape HC (for use in Hot Climates, minimum 50°F (10°C))

F. Prefabricated Drainage and Protection Composite for Vertical Applications: Hydroduct® 220 Drainage Composite by GCP Applied Technologies, Inc.. Drainage Composite shall be designed to promote positive drainage while serving as a protection course.

G. Prefabricated Drainage and Protection Composite for Horizontal Applications: Hydroduct® 660 Drainage Composite by GCP Applied Technologies, Inc.. Drainage Composite shall be designed to promote positive drainage while serving as a protection course.

H. Strip Waterstop: Adcor™ ES hydrophilic non-bentonite waterstop by GCP Applied Technologies, Inc. for non-moving concrete construction joints and penetrations.

I. Gun-Grade Waterstop: Swellseal WA hydrophilic gun-grade waterstop by DeNeef/GCP Applied Technologies, Inc. for non-moving concrete construction joints and penetrations.

J. Miscellaneous Materials: Primer, mastic, liquid membrane, tape and accessories specified or acceptable to manufacturer of sheet membrane waterproofing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 PREPARATION OF SUBSTRATES

A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods which are acceptable to manufacturer of sheet membrane waterproofing.

B. Horizontal Substrates to receive Pre-Applied Waterproofing Sheet Membrane

1. It is essential to create a sound and solid substrate to eliminate movement during the concrete pour. Substrates must be regular and smooth with no gaps or voids greater than 0.5 in. (12 mm). Grout around all penetrations such as utility conduits, etc. for stability.
2. The substrate must be free of loose aggregate and sharp protrusions. Avoid curved or rounded substrates. When installing over earth or crushed stone, ensure substrate is well compacted to avoid displacement of substrate due to traffic or concrete pour. The surface does not need to be dry, but standing water must be removed.

C. Vertical Cast-In-Place Concrete Wall Substrates:

1. Do not proceed with installation until concrete has properly cured and dried.
2. Fill form tie rod holes with concrete and finish flush with surrounding surface.
3. Repair bugholes over 13 mm (0.5 in.) in length and 6 mm (0.25 in.) deep and finish flush with surrounding surface.
4. Remove scaling to sound, unaffected concrete and repair exposed area.
5. Grind irregular construction joints to suitable flush surface.

D. Vertical Masonry Substrates: Apply waterproofing over concrete block and brick with smooth trowel-cut mortar joints or parge coat.

E. Related Materials: Treat joints and install flashing as recommended by waterproofing manufacturer.

3.3 INSTALLATION

A. Strictly comply with installation instructions in manufacturer's published literature.

B. If required, install prefabricated drainage and protection composite for horizontal applications per manufacturer's requirements.

C. Horizontal application of pre-applied sheet waterproofing membrane.

1. Place the membrane HDPE film side to the substrate with the yellow zip strip facing towards the concrete pour. End laps should be staggered to avoid a build-up of layers.
2. Accurately position succeeding sheets to overlap the previous sheet 3 in. (75 mm) along the marked selvedge. Ensure the underside of the succeeding sheet is clean, dry and free from contamination before attempting to overlap.
3. Peel back the clear plastic release liner in the overlap area to expose the adhesive in the selvedge area and adhere underside of successive sheet onto the adhesive, lining up leading edge with marked selvedge line. Achieve an adhesive bond at the overlap.
4. Ensure a continuous bond is achieved without creases and roll firmly with a heavy roller.
5. Overlap all roll ends and cut edges by a minimum 3 in. (75 mm) and ensure the area is clean and free from contamination, wiping with a damp cloth if necessary.
6. Allow to dry and apply Preprufe Tape LT (or HC in hot climates) centered over the lap edges and roll firmly. Apply additional Preprufe Tape LT (or HC in hot climates) a minimum of 2 in. beyond all edges of membrane that are not sealed by the selvedge.
7. Immediately remove printed plastic release liner from the Preprufe Tape.
8. Center Preprufe CJ Tape LT (or HC in hot climates) under locations of all control joints in the concrete slab and adhere the Preprufe CJ Tape to the top of pre-applied waterproofing membrane.
9. Immediately remove printed plastic release liner from the Preprufe CJ Tape.
10. Protect membrane in accordance with manufacturer's recommendations until placement of concrete. Inspect for damage just prior to placement of concrete and make repairs in accordance with manufacturer's recommendations.

D. Strip Waterstop Installation

1. Refer to Section 03 15 13 "Waterstops".

E. Vertical application of sheet membrane waterproofing system.

1. Apply primer at rate recommended by manufacturer. Recoat areas not waterproofed if contaminated by dust. Mask and protect adjoining exposed finish surfaces to protect those surfaces from excessive application of surface conditioner.
2. Delay application of membrane until primer is sufficiently dry. Dry time will vary with weather conditions.
3. Seal daily terminations with troweled bead of mastic.
4. Apply protection board and related materials in accordance with manufacturer's recommendations.
5. Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work.
6. Install prefabricated drainage and protection composite for vertical applications per manufacturer's requirements.

3.4 FIELD QUALITY CONTROL

A. Architectural precast concrete installer shall provide field quality control by PCI certified staff and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
    a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
    b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

B. Testing Agency: Construction Manager will engage a qualified testing agency to perform tests and inspections and prepare test reports.

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

D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

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

END OF SECTION 07 13 26

SECTION 07 14 18 - FLUID-APPLIED WATERPROOFING DECK SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 SUMMARY

A. The work of this section includes, but is not limited to, the following:

1. Fluid applied waterproofing system
2. Prefabricated drainage composite
3. Protection board
4. Insulation

B. System Description: The fluid applied membrane shall consist of the following:

1. Vertical Application: Vertical applications at parapet walls, upstands, etc. shall be coated with a minimum thickness of 80 mils applied in two 40 mil layers
2. Horizontal Application: Horizontal applications shall be coated with a minimum thickness of 80 mils applied in one 80 mil layer.

C. Related Sections: Other specification sections which directly relate to the work of this section include, but are not limited to, the following:

1. Section 03 30 00 – Cast-In-Place Concrete
2. Section 04 20 00 – Unit Masonry
3. Section 07 60 00 – Flashing and Sheet Metal
4. Section 07 92 00 – Joint Sealants
5. Section 07 95 13.16 – Exterior Expansion Joint Cover Assemblies

1.3 REFERENCE STANDARDS

A. The following standards and publications are applicable to the extent referenced in the text. The most recent version of these standards is implied unless otherwise stated.

B. American Society for Testing and Materials (ASTM)

1. C 836 Standard Specification for High Solids, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course
2. C 898 Standard Guide for Use of High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane with Separate Wearing Course
3. D 412 Standard Test Methods for Rubber Properties in Tension
4. D 4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
5. D 624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

6. E 96 Standard Test Method for Vapor Transmission of Materials
7. D 3767 Standard Practice for Rubber - Measurements of Dimensions
8. D 2240 Standard Test Method for Rubber Property – Durometer Hardness

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations.

B. Shop drawings showing locations and extent of waterproofing including details for terminations and flashings, projections, penetrations, drains and treatment of substrate joints and cracks.

C. Written documentation demonstrating installer's qualifications under the "Quality Assurance" article including reference projects of a similar scope.

D. Samples: Submit representative samples of the following for approval:

1. Fluid applied membrane
2. Protection board (if applicable)
3. Prefabricated drainage composite (if applicable)
4. Insulation board (if applicable)

E. Warranty: Submit a sample warranty identifying the terms and conditions stated below.

1.5 QUALITY ASSURANCE

A. Manufacturer: Waterproofing systems shall be manufactured and marketed by a firm with a minimum of 20 years' experience in the production and sales of waterproofing. Manufacturers proposed for use, but not named in these specifications shall submit evidence of ability to meet all requirements specified, and include a list of projects of similar design and complexity completed within the past five years.

B. Installer: The installer shall demonstrate qualifications to perform the work of this Section by submitting the following:

1. Certification or written license from the Waterproofing Manufacturer that the Installer is a certified applicator.
2. List of at least three (3) projects contracted within the past five (5) years of similar scope and complexity to this project.
3. Installer must show evidence of adequate equipment and trained field personnel to successfully complete the project in a timely manner.
4. Installer's credentials must be approved by both the Architect and the Waterproofing Materials Manufacturer.

C. Materials: Fluid applied waterproofing material shall be two part 100% solids chemically crosslinked monolithic elastomer system free of bitumen. For each type of material required for the work of this section, provide primary materials that are the products of one manufacturer.

D. Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of surface preparation, minimum curing period, installation procedures, special details and flashings, inspection, testing, protection and repair procedures.

E. Inspection and Testing: All areas shall be tested by means of electronic testing or ponding to a minimum depth of 2 in. (50 mm) for a period of 24 hours and inspected an individual/firm approved by the waterproofing systems manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials and products in the original, unopened containers with seals unbroken, labeled with the manufacturer's name, product brand name and type, date of manufacture and directions for storage and use.

B. Store and handle materials in strict compliance with manufacturer’s instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.

1. Do not double-stack pallets of waterproofing on the job site. Provide cover on top and all sides, allowing for adequate ventilation.
2. Store drainage composite or protection board flat and off the ground. Provide cover on top and all sides.
3. Protect waterproofing materials from freezing.

C. B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.7 PROJECT CONDITIONS

A. Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.

B. Proceed with installation only when substrate construction and preparation work is complete and in condition to receive membrane waterproofing.

C. Do not allow waste products (i.e. petroleum, grease, oil, solvents, vegetable or mineral oil, animal fat, acids, etc.) to come into contact with the waterproofing membrane. Any exposure to foreign materials or chemical discharges must be presented to the Membrane Manufacturer to determine the impact on the waterproofing assembly performance.

D. Concrete Deck Surface condition:

1. Ensure no excessive deflection or movement of the deck or other structural problems.

2. The deck shall provide for support of the maximum anticipated dead and environmental loads and for expansion and contraction suitable for the roof system structure.
3. All projections, penetrations and openings in the deck should be completed before the waterproofing application begins.
4. Joints in pre-cast/pre-stressed concrete decks are to be grouted so that the top surface is level and smooth before membrane application.

E. General contractor shall assure adequate protection and ventilation during the application of the Waterproofing assembly.

1.8 WARRANTY

A. Fluid-Applied Waterproofing Deck System: Upon completion of the fluid-applied waterproofing deck system, the contractor must submit a written warranty for the waterproofing materials signed by the Waterproofing Manufacturer.

B. Warranties available from the manufacturer:

1. Material Warranties:
   a. Manufacturer's standard ~~20-year~~10-year material warranty.

PART 2 - PRODUCTS

2.1 FLUID APPLIED WATERPROOFING MEMBRANES

A. Basis-of-Design Product: Subject to compliance with requirements, provide the following Fluid Applied Waterproofing Membranes: GCP Applied Technologies, Silcor® 900HA

B. Waterproofing Membrane Physical Properties:

Physical Properties Silcor 900HA	**Typical Value**	**Test Method**
Resistance to hydrostatic head over post formed crack head	>230 ft	ASTM D5385
Tensile strength	1450 psi	ASTM D412
Elongation	450%	ASTM D412
Tear strength	> 228 lb/in	ASTM D624 C
Adhesion to concrete	> 300 psi or concrete failure[1]	ASTM D4541
Shore Hardness	75 A	ASTM D2240
Low temperature crack bridging	Pass	ASTM C836
Abrasion resistance (Taber Wear Index)	186 mg[2]	
Setting time[3]	30 min. tack free; 2-3 hrs foot trafficable	Internal

Footnote:

1. *Tested on prepared, primed, and sand cast concrete.*
2. *H18/1000 cycles/1000g*
3. *At 73F*

2.2 ACCESSORIES

A. Protection Board:

1. Prefabricated Drainage Composite
   a. Hydroduct® 660 Drainage Composite by GCP Applied Technologies for horizontal surfaces. Hydroduct 220 Drainage Composite by GCP Applied Technologies for all vertical surfaces. Drainage composite shall be designed to promote positive drainage while serving as a protection course.

PART 3 - EXECUTION

3.1 EXAMINATION

A. The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 PREPARATION OF SUBSTRATES

A. Refer to manufacturer's literature for requirements for preparation of substrates. Surfaces shall be structurally sound and free of voids, spalled areas, loose aggregate and sharp protrusions. Remove contaminants such as grease, oil and wax from exposed surfaces. Remove dust, dirt, loose stone and debris. Use repair materials and methods that are acceptable to manufacturer of the fluid applied waterproofing.

B. Cast-In-Place Concrete Substrates:

1. Poured in-place concrete must be monolithic, smooth, and free of unapproved curing compounds, form release agents and other surface contaminants.
2. The surface must be cured for a minimum of 28-days and have an International Concrete Repair Institute (ICRI) Concrete Surface Profile (CSP) of 2-5 with a moisture content of 5% or less.
3. Fill form tie rod holes with concrete and finish flush with surrounding surface.
4. Repair bugholes over 0.5 in. (13 mm) in length and 0.25 in. (6 mm) deep and finish flush with surrounding surface.
5. Remove scaling to sound, unaffected concrete and repair exposed area.
6. Grind irregular construction joints to suitable flush surface.

C. Masonry Substrates: Apply waterproofing over concrete block and brick with smooth trowel-cut mortar joints or parge coat.

D. Substrate Cleaning:

1. Thoroughly sweep the substrate that is to receive the waterproofing membrane.
2. Substrate must also be blown using oil free air to remove any remaining loose debris.
3. A final check to determine if the substrate is sufficiently clean is to apply a test patch of the system and check its adhesion.

3.3 INSTALLATION

A. Apply primer at rate recommended by manufacturer.

B. Detailing: All details (including inside corners, outside corners, pipe penetrations, drains, cracks, construction joints, etc.) should be treated before application of the field of the membrane according to manufacturer's drawings and written application instructions.

C. Vertical Application:

1. Apply 2 coats at a minimum thickness of 40 mils (1.0 mm) over all vertical areas to be waterproofed. Perform wet film thickness tests as work progresses to confirm thickness.

D. Horizontal Application:

1. Apply at a minimum thickness of 80 mils (2.0 mm) over all horizontal areas to be waterproofed. Perform wet film thickness tests as work progresses to confirm thickness.

3.4 WATER TEST/LEAK DETECTION

A. All areas of the deck must be water tested by means of electronic testing or ponding to a minimum depth of 2 in. (50 mm) for a period of 24-hours to confirm the integrity of the membrane.

B. Allow the membrane to cure for a minimum period of 24 hours before starting water tests.

C. Before flood testing, be sure the structure will withstand the dead load of the water.

D. For well-sloped decks, segment the flood test to avoid deep water near drains.

E. Mark any leaks and repair according to manufacturer's repair procedures when the membrane is dry.

F. Re-test all areas after repairs have been completed.

3.5 FIELD QUALITY CONTROL

A. Waterproofing installer shall provide field quality control by manufacturer certified staff and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

3.6 CLEANING AND PROTECTION

A. Remove any masking materials after installation. Clean any stains on materials that would be exposed in the completed work.

B. Install any protection, drainage and insulation courses according to the manufacturer's instructions.

3.7 JOB COMPLETION

A. Contractor and a Representative of the Membrane Manufacturer shall inspect the waterproofing assembly and notify the Architect of any defects. Waterproofing manufacturer shall approve installation prior to installation of overburden.

B. Clean up all debris and equipment.

END OF SECTION 07 14 18

SECTION 07 16 13 - POLYMER MODIFIED CEMENT 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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section includes polymer-modified cement waterproofing.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for the finishing of concrete walls and slabs to receive waterproofing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and installation instructions.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Low Emitting Materials
   a. Documentation on Low Emitting Materials.

C. Samples for Initial Selection: For each type of exposed product.

1. Include Samples of available color selection.

D. Samples for Verification: For each type of waterproofing indicated, in manufacturer's standard sizes.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator.

B. Product Certificates: For each type of waterproofing, patching, and plugging material.

C. Product Test Reports: For each product formulation, for tests performed by manufacturer and witnessed by a qualified testing agency.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying polymer-modified cement waterproofing similar in material, design, and extent to that indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit polymer-modified cement waterproofing to be performed according to manufacturer's written instructions.

B. Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

C. Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 40 deg F or above during work and cure period, and space is well ventilated and kept free of water.

PART 2 - PRODUCTS

2.1 FIELD-MIXED, POLYMER-MODIFIED CEMENT WATERPROOFING

A. Sustainable Design Requirements

1. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
2. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.

B. Manufacturer

1. Basis-of-Design Product: Subject to compliance with requirements, provide SikaTop Seal 107 or comparable product by one of the following:
   a. BASF Corporation.
   b. Euclid Chemical Company (The); an RPM company.

C. Materials

1. Polymer-modified portland cement coating:
   a. Component “A”: A liquid polymer emulsion of an acrylic co-polymer base and additives.
   b. Component “B”: A blend of selected portland cements, specially graded aggregates, and admixtures to control setting time and workability.
   c. The ratio of Component A: Component B shall be:
      1) Slurry 1:4 by weight
      2) Mortar 1:4.5 by weight

d. The material shall be non-combustible, either before or after cure.

2.2 PERFORMANCE CRITERIA

1. Properties of the mixed polymer-modified portland cement coating:
   a. Pot Life: Approx. 60 minutes at 68F Approx. 30 minutes at 86F
   b. Color: gray
2. Properties of the cured polymer-modified portland cement coating:
   a. Tensile Strength (ASTM C-307) 28 days
      1) Type Gray 990 psi (6.8 Mpa)
   b. Bond Strength (ACI 503R-30 Modified): Pull-off test
   c. Moisture Vapor permeability (ASTM E96)
      1) 28 days 18 perms
   d. Compressive Strength (ASTM D-695) at 28 days
      1) Type Gray 3400 psi (23.4 Mpa)
   e. Flexibility (ASTM D522 Modified)
      1) Approxmatly 25%
   f. Carbon Dioxide Diffusion
      1) Coefficient (uCO_2) Approx. 35,000 equivalent to 6 inches of concrete
   g. Watertightness under Hydrostatic Pressure (DIN 1048 Mod.)

Water Pressure		Penetrated Water		Water Absorption	
Feet	(bar)	Grains	(grams)	Grains Ft^2 * Hr	(grams) m^2 *Hr
16	(0.5)	0	(0)	0	(0)
33	(1)	15	(1)	3	(2)
99	(3)	31	(3)	10	(7)

Rendering mortars absorbing less than 91 grains/$ft.^2$ * h (64 grams/m^2 *h) are considered watertight.

   h. The material shall not produce a vapor barrier.
   i. The material meets the chemical requirements in accordance with ANSI/NSF Standard 61- potable water approval.
   j. The material shall be thermally compatible with portland cement mortar and concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.

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

C. Notify Architect in writing of active leaks or defects that would affect system performance.

3.2 SURFACE PREPARATION

A. Substrate must be clean, sound, and free of surface contaminants. Remove dust, laitance, grease, oils, curing compounds, form release agents and all foreign particles by mechanical means.

B. Substrate will be in accordance with ICRI Guideline No. 03732 for coatings and fall within CSP4.

1. Prepare concrete surface to have open-textured, sandpaper-like finish.

C. All surfaces must be saturated surface dry (SSD), with no standing water at time of application.

3.3 MIXING AND APPLICATION

A. A. Mixing: Under normal circumstances, full quantities of both components are mixed together, a slurry consistency will result. For a trowelable consistency use only 90% of component A. Mix in a clean container by slowly adding the powder component to the liquid component and mixing with a slow speed (400-600rpm) drill and mixing paddle.

B. Coating Application: Apply trowel, notched trowel, stiff bristle brush, or spray equipment. Work material into the prepared substrates, filling all pores and voids.

1. For trowel consistency: Apply the first coat with a notched trowel and leave to harden (4 to 8 hours). Apply the second coat with a flat trowel.

C. C. When applying the coating, never stop the application until the entire surface has been coated. Always stop application at an edge, corner, or joint. Never let a previously coated film dry; always coat into a wet film. Always apply the coating at a 45^{o} angle to an edge, corner, or joint.

D. Adhere to all limitations and cautions for the polymer-modified cement coating in the manufacturer's printed literature.

E. Cure material per manufacturer recommendations for temperature range and relative humidity to achieve performance criteria.

1. 71 degrees Fahrenheit-75 degrees Fahrenheit and 45%-55% relative humidty.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a manufacturer’s site representative qualified to inspect substrate conditions, surface preparation, application, flashings, protection, and drainage components; and to furnish weekly reports to Architect. Manufacturer’s representative shall approve application.

B. Waterproofing will be considered defective if it does not pass tests and inspections.

3.5 CLEANING

A. The uncured polmer-modified portland cement coating can be cleaned from tools with water. The cured polymer- modified portland cement coating coating can only be removed mechanically.

B. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION 07 16 13

SECTION 07 18 00 - TRAFFIC COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes traffic coatings for the following applications:

1. Pedestrian traffic.

B. Related Requirements:

1. Section 03 30 00 “Cast-in-Place Concrete”.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include installation instructions and details, material descriptions, dry or wet film thickness requirements, and finish.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

C. Shop Drawings: For traffic coatings.

1. Include details for treating substrate joints and cracks, flashings, deck penetrations, and other termination conditions that are not included in manufacturer's product data.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For each type of exposed finish, prepared on rigid backing.

1. Provide stepped Samples on backing to illustrate buildup of traffic coatings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of traffic coating.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For traffic coatings to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build mockup for each traffic coating and substrate to receive traffic coatings.
2. Size: 200 sq. ft. of each substrate to demonstrate surface preparation, joint and crack treatment, thickness, texture, color, and standard of workmanship.
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. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Apply traffic coatings within the range of ambient and substrate temperatures recommended in writing by manufacturer. Do not apply traffic coatings to damp or wet substrates, when temperatures are below 40 deg F, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.

1. Do not apply traffic coatings in snow, rain, fog, or mist, or when such weather conditions are imminent during the application and curing period. Apply only when frost-free conditions occur throughout the depth of substrate.

B. Do not install traffic coating until items that penetrate membrane have been installed.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace traffic coating that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Adhesive or cohesive failures.
   b. Abrasion or tearing failures.
   c. Surface crazing or spalling.
   d. Intrusion of water, oils, gasoline, grease, salt, deicer chemicals, or acids into deck substrate.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations:

1. Obtain traffic coatings from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Material Compatibility: Provide primers; base coat, intermediate coat, and topcoat; and accessory materials that are compatible with one another and with substrate under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

2.3 TRAFFIC COATING

A. Traffic Coating: Manufacturer's standard, traffic-bearing, seamless, high-solids-content, cold liquid-applied, elastomeric, water-resistant membrane system with integral wearing surface for pedestrian traffic and equipment-room floor; according to ASTM C 957/C 957M.

1. Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Construction Systems; MasterSeal Traffic 2000 (Pre-2014: Conipur Plus) or a comparable product by one of the following:
   a. Advanced Polymer Technology Corporation.
   b. Pecora Corporation.

B. MATERIALS

1. Basecoat: MasterSeal M200
2. Topcoat: MasterSeal TC275
3. Topcoat: MasterSeal 295
4. Aggregate: MasterSeal 941
5. Clean-up: MasterSeal 990
6. Sealant Primer: MasterSeal P173
7. Sealant: MasterSeal NP2, SL2, or CR195
8. Deep joint Sealant: MasterSeal NP2 or SL2
9. Plywood Joint Sealant: MasterSeal NP1, NP2, or CR195
10. Reinforcing Fabric: MasterSeal 995

2.4 ACCESSORY MATERIALS

A. Joint Sealants: As specified in Section 07 92 00 "Joint Sealants."

B. Sheet Flashing: Nonstaining sheet material recommended in writing by traffic-coating manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, surface smoothness, and other conditions affecting performance of traffic-coating work.

B. Verify that substrates are visibly dry and free of moisture.

1. Test for moisture according to ASTM D 4263.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of traffic-coating work.

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

1. Begin coating application only after substrate construction and penetrating work have been completed.
2. Begin coating application only after minimum concrete-curing and -drying period recommended in writing by traffic-coating manufacturer has passed and after substrates are dry.
3. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Clean and prepare substrates according to ASTM C 1127 and manufacturer's written instructions to produce clean, dust-free, dry substrate for traffic-coating application. Remove projections, fill voids, and seal joints if any, as recommended in writing by traffic-coating manufacturer.

B. Priming: Unless manufacturer recommends in writing against priming, prime substrates according to manufacturer's written instructions.

1. Limit priming to areas that will be covered by traffic-coating material on same day. Reprime areas exposed for more time than recommended by manufacturer.

C. Schedule preparation work so dust and other contaminants from process do not fall on wet, newly coated surfaces.

D. Mask adjoining surfaces not receiving traffic coatings to prevent overspray, spillage, leaking, and migration of coatings. Prevent traffic-coating materials from entering deck substrate penetrations and clogging weep holes and drains.

3.3 TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through traffic coatings and at expansion joints, drains, and sleeves according to ASTM C 1127 and manufacturer's written instructions.

B. Provide sealant cants at penetrations and at reinforced and nonreinforced, deck-to-wall butt joints.

C. Terminate edges of deck-to-deck expansion joints with preparatory base-coat strip.

3.4 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrates according to ASTM C 1127 and manufacturer's written recommendations. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Comply with recommendations in ASTM C 1193 for joint-sealant installation.

B. Apply reinforcing strip in traffic-coating system where recommended in writing by traffic-coating manufacturer.

3.5 TRAFFIC-COATING APPLICATION

A. Apply traffic coating according to ASTM C 1127 and manufacturer's written instructions.

B. Apply coats of specified compositions for each type of traffic coating at locations as indicated on Drawings.

C. Start traffic-coating application in presence of manufacturer's technical representative.

D. Uniformly broadcast and embed aggregate in each coat indicated to receive aggregate according to manufacturer's written instructions. After coat dries, sweep away excess aggregate.

E. Apply traffic coatings to prepared wall terminations and vertical surfaces to height indicated; omit aggregate on vertical surfaces.

F. Cure traffic coatings. Prevent contamination and damage during coating application and curing.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform the following field tests and inspections:

1. Materials Testing:
    a. Samples of material delivered to Project site shall be taken, identified, sealed, and certified in presence of Contractor.
    b. Testing agency shall perform tests for characteristics specified, using applicable referenced testing procedures.
    c. Testing agency shall verify thickness of coatings during traffic-coating application for each 600 sq. ft. of installed traffic coating or part thereof.

B. Final Traffic-Coating Inspection: Arrange for traffic-coating manufacturer's technical personnel to inspect membrane installation on completion.

1. Notify Architect or Owner 48 hours in advance of date and time of inspection.

C. Waterproofing will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 PROTECTING AND CLEANING

A. Protect traffic coatings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Refer to Section 01 74 23 “Final Cleaning” for additional requirements.

END OF SECTION 07 18 00

SECTION 07 1801 - TRAFFIC COATINGS - PARKING GARAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:

1. Division 07 Section, “Traffic Coatings (Parking Garage).”
2. Division 07 Section, “Water Repellents (Parking Garage.”
3. Division 07 Section, “Joint Sealants (Parking Garage).”
4. Division 07 Section, “Expansion Control (Parking Garage).”

B. This Section includes traffic topping: Fluid applied, waterproofing, traffic-bearing elastomeric membrane with integral wearing surface, where the surface to which membrane is to be applied is one or more of the following:

1. Over occupied space.
2. Over utility rooms.(Electrical, mechanical, IDF, etc.)
3. At slab pour strips and construction joints per details.
4. At heavy pedestrian traffic areas such as pedestrian walkways as shown on the drawings.

C. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.

D. Related Sections: Following Sections contain requirements that relate to this Section.

1. Division 03 Section, "Cast-in-Place Concrete (Parking Garage)."
2. Division 07 Section, "Fire Resistive Joint Firestopping."
3. Division 07 Section, “Water Repellents (Parking Garage).”
4. Division 07 Section, “Joint Sealants (Parking Garage).”
5. Division 07 Section, “Expansion Control (Parking Garage).”
6. Division 09 Section, "Painting."

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
2. Distribute reviewed submittals to all others whose Work is related.

B. Make submittals in accordance with requirements of Division 01 Section, “Shop Drawings, Product Data, and Samples~~Submittal Procedures~~:”

1. See requirements of Division 01 Section, “Shop Drawings, Product Data, and Samples~~Submittal Procedures~~,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.

2. See requirements of Division 01 Section, "Shop Drawings, Product Data, and Samples~~Submittal Procedures~~," Part 2 heading, "Requests for Information," for RFI constraints.

1.4 ACTION SUBMITTALS

A. Product Data: For each system indicated at least 60 days prior to application.

1. Product description, technical data, appropriate applications and limitations.
2. Primer type and application rate
3. Material, and wet mils required to obtain specified dry thickness for each coat.
4. Type, gradation and aggregate loading required within each coat.

B. Samples:

1. One 4 in. by 4 in. stepped sample showing each component for each system indicated.

C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

A. Certificates

1. Certification that products and installation comply with applicable federal, state of Florida, and local EPA, OSHA and VOC requirements regarding health and safety hazards including project LEED requirements.
2. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.
3. Certification from the Manufacturer that finishes as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive traffic topping.
4. Certification stating static coefficient of friction meets minimum requirements of Americans with Disabilities Act (ADA).
5. Certification stating materials have been tested and listed for UL 790 Class "A" rated materials/system by UL for traffic topping application specified on project. Containers shall bear UL labels.
6. Certification from manufacturer confirming compatibility with existing underlying coatings and/or substrate.

B. Manufacturer's Instructions: for each system indicated.

1. Crack treatment and surface preparation method and acceptance criteria.
2. Method of application of each coat.
3. Maximum and minimum allowable times between coats.
4. Final cure time before resumption of parking and/or paint striping.
5. Any other special instructions required to ensure proper installation.

C. Field Quality Control:

1. Quality Control Plan as defined in Part 3.
2. Two copies each of manufacturer's technical representative's log for each visit.
3. Testing agency field reports.

D. Qualification Statements

1. Manufacturer's qualifications as defined in the "Quality Assurance" article.

2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

A. Three copies of System Maintenance Manual.

B. Final executed Warranty.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted system, to include:

a. Name and location of project.

b. Type of system applied.

c. On-Site contact with phone number.

B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.

C. Installer's Qualifications: Owner retains right to reject any ~~manufacturer~~Installer.

1. Evidence of compliance with Summary article paragraph "A single installer. . ."
2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.

D. Testing Agency: Independent testing laboratory employed by Contractor and acceptable to Engineer/Architect.

E. Certifications

1. Traffic Topping shall satisfy the current National Volatile Organic Compound (VOC) Emission Standards for Architectural Coatings.
2. Licensing/certification document from manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of Florida.
3. Licensing/certification agreement shall include following information:

a. Applicator's financial responsibility for warranty burden under agreement terms.

b. Manufacturer's financial responsibility for warranty burden under agreement terms.

c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.

d. Authorized signatures for both Applicator Company and Manufacturer.

e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. Do not store material on slabs to be post-tensioned before final post-tensioning of slabs is accomplished. At no time shall weight of stored material being placed on slab area, after post-tensioning is completed and concrete has reached specified 28 day strength, exceed total design load of slab area. Between time final post-tensioning is accomplished and time concrete has reached specified 28 day strength, weight of stored material placed on slab area shall not exceed half total design load of slab area.

1.9 FIELD CONDITIONS

A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY

A. System Manufacturer: Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and applicator with regard to warranty requirements (Joint and Several). The warranty shall provide that system will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any adhesive or cohesive failures.
2. Spalling surfaces.
3. Weathering.
4. Surface crazing (does not apply to traffic topping protection course).
5. Abrasion or tear failure resulting from normal traffic use.
6. Failure to bridge cracks less than 0.0625 in. or cracks existing at time of traffic topping installation on double tees only.

B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.

C. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of substantial completion.

D. Perform any repair under this warranty at no cost to Owner.

E. Address the following in the terms of the Warranty: length of warranty, change in value of warranty – if any- based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures,

dispute resolution procedures, and limitations of liability for direct and consequential damages.

F. Vandalism and abnormally abrasive maintenance equipment are not normal traffic use and are exempted from warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:

1. Advanced Polymer Technology (APT), Harmony, PA
2. BASF Building Systems (BASF), Shakopee, MN
3. Deneef Construction Chemicals (Deneef), Houston, TX.
4. Lymtal International Inc. (Lymtal), Lake Orion, MI.
5. Neogard Division of Jones-Blair Company (Neogard), Dallas, TX.
6. Pacific Polymers, Inc. a Division of ITW (Pacific Polymers), Garden Grove, CA
7. Poly-Carb Inc. (Poly-Carb), Solon, OH.
8. Polycoat Products Division of Amer. Polymers (Polycoat), Santa Fe Springs, CA.
9. Pecora Corporation (Pecora), Harleysville, PA
10. Sika Corporation (Sika), Lyndhurst, NJ.
11. Technical Barrier Systems, Inc. (TBS), Oakville, Ontario.
12. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, TRAFFIC TOPPING

A. Acceptable low odor toppings are listed below. One will be selected as an alternate. In bid form, list bid price for each topping listed below. Contract for topping will not necessarily be directed to lowest bid priced topping. Toppings shall be compatible with all other materials in this Section and related work.

1. VOC Compliant, Extreme Low Odor, High-Solids (100%), Heavy Duty Coating System):
    a. AutoGard FC HD-48, Autogard E, Neogard.
    b. Conipur II Deck Coating System, BASF.
    c. Flexodeck Mark 170.2, Poly-Carb.
    d. Iso-Flex 760 U HL AR and 760 U HL AL, Lymtal.
    e. Kelmar FCW III, exposure 2 or 3, TBS.
    f. Sikalastic 720/745, Sika.
    g. Vulkem 360NF/950NF and 951NF, Tremco.

B. Provide ultraviolet screening for all traffic topping placed on this project.

C. Finish top coat shall be colored grey.

D. Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

2.3 MATERIALS, CRACK SEALER

A. Repair for isolated random horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products:

1. SikaPronto 19TF, Sika.
2. Degadeck, Crack Sealer Plus, BASF.
3. Denedeck Crack Sealer, Deneef.
4. Iso-Flex 609 Epoxy Crack Sealer, Lymtal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.

B. Coordinate and verify that related Work meets following requirements before beginning surface preparation and application:

1. Concrete surfaces are finished as acceptable for system to be installed. Correct all high points, ridges, and other defects in a manner acceptable to the Engineer/Architect.
2. Curing compounds used on concrete surfaces are compatible with system to be installed.
3. Concrete surfaces have completed proper curing period for system selected.
4. Joint Sealants are compatible with traffic toppings.

3.2 PREPARATION

A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

B. Acid etching is prohibited.

C. Remove all laitance and surface contaminants, including oil, grease and dirt by shotblasting. Prepare by sandblasting all surfaces inaccessible to shotblast equipment.

D. Before applying materials, apply system to small area to assure that it will adhere to substrate and joint sealants and dry properly and to evaluate appearance.

E. All cracks on concrete surface shall be prepared in accordance with manufacturer's recommendations.

F. Mask off adjoining surfaces not to receive traffic topping and mask off drains to prevent spillage and migration of liquid materials outside membrane area. Provide neat/straight lines at termination of traffic topping.

3.3 INSTALLATION/APPLICATION

A. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions

(including relative humidity and temperature), coverages, mil thicknesses and texture, and as shown on Drawings.

B. A primer coat is required for all systems. No exception.

C. Do not apply traffic topping material until concrete has been air dried at temperatures at or above 40ºF. for at least 30 days after curing period specified.

D. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40ºF.

E. All adjacent vertical surfaces shall be coated with traffic topping minimum of 4 in. above coated horizontal surface. Requirement includes, but is not limited to pipes, columns, walls, curbs (full height of vertical faces of all curbs) and islands.

F. Complete all Work under this Section before painting line stripes.

G. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

3.4 FIELD QUALITY CONTROL

A. Develop a quality control plan for assured specified uniform membrane thickness that utilizes grid system of sufficiently small size to designate coverage area of not more than 5 gallons at specified thickness. In addition, employ wet mil gauge to continuously monitor thickness during application. Average specified wet mil thickness shall be maintained within grid during application with minimum thickness of not less than 80% of average acceptable thickness. Immediately apply more material to any area not maintaining these standards.

B. Testing Agency employ wet mil gauge to periodically monitor thickness during application.

C. Install 1 trial section of topping system for each duty grade specified. Do not proceed with further topping application until trial sections accepted in writing by Engineer/Architect. Remove and replace rejected trial sections with acceptable application. Trial section shall also be tested for:

1. Wet mil thickness application.
2. Adhesion to concrete substrate.
3. Overall dry mil thickness.

D. Use trial sections to determine adequacy of pre-application surface cleaning. Obtain Owner, Engineer/Architect and manufacturer acceptance of cleaning before proceeding with topping application.

E. Determine overall topping system mil thickness:

1. Contractor shall provide 6 in. by 6 in. bond breaker (topping coupon) on concrete surface for each 25,000 sq ft, or fraction thereof, of topping to be placed as directed by Engineer/Architect and manufacturer. Dimensionally locate coupon for easy removal.
2. Contractor shall assist Testing Agency in removing topping coupons from concrete surface at completion of manufacturer-specified cure period. Contractor shall repair coupon area per topping manufacturer's instructions.
3. Testing Agency shall determine dry mil thickness of completed Traffic Topping System, including bond breaker. Take 9 readings (minimum), 3 by 3 pattern at

2 in. on center. No reading shall be taken closer than 1 in. from coupon edge. Report individual readings and overall topping system average to Engineer/Architect. Readings shall be made with micrometer or optical comparator.

F. Installer shall provide weekly inspection log verifying all locations have been inspected and are free of installation defects or damage. Log should include specific locations and repairs performed. Log should be submitted to Contractor, Architect, OAR and Owner.

END OF SECTION

SECTION 07 19 00 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes penetrating water-repellent treatments for the following exposed vertical and horizontal surfaces ~~in all spaces~~ other than those in the open air parking garage. For open air parking garage areas, refer to Section 07 19 01 “Water Repellents – Parking Garage”. Non-exposed surfaces (those with finishes applied) are not required to be treated with penetrating water-repellents.

1. Exterior Cast-in-place concrete.
2. Exterior Precast concrete.
3. Exterior Concrete unit masonry.
4. Interior surfaces as indicated.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. ACTION SUBMITTALS

C. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Paints and Coatings

D. Product Data: For each type of product.

1. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Applicator.

B. Product Certificates: For each type of water repellent.

C. Preconstruction Test Reports: For water-repellent-treated substrates.

D. Field quality-control reports.

E. Sample Warranty: For special warranty.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction to demonstrate surface preparation and application of water repellents.
   a. Coordinate construction of mockups to permit inspection by owners' testing agency.
   b. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
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. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 FIELD CONDITIONS

A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:

1. Concrete surfaces and mortar have cured for not less than 28 days.
2. Building has been closed in for not less than 30 days before treating wall assemblies.
3. Ambient temperature is above 40 deg F and below 100 deg F and will remain so for 24 hours.
4. Substrate is not frozen and substrate-surface temperature is above 40 deg F and below 100 deg F.
5. Rain or snow is not predicted within 24 hours.
6. Not less than 24 hours have passed since surfaces were last wet.
7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer and Applicator agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS

A. Penetrating Water Repellent: Clear; with alcohol, mineral spirits, water, or other proprietary solvent carrier.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. SINAK Corporation, HLQ-125.
   b. PROSOCO, Inc; Consolideck SLX100 Water & Oil Repellent.
   c. W. R. Meadows, Inc; DECK-O-SHIELD.

B. Low Emitting Paints & Coatings

1. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
2. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.

1. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
3. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

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

3.2 PREPARATION

A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, according to repellent manufacturer's written instructions.

B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions.

C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

D. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.

E. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.

1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.

B. Apply coating of water repellent on surfaces to be treated using 15 psi-pressure spray with a fan-type spray nozzle or brush to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.

1. Precast Concrete: At Contractor's option, first application of water repellent may be completed before installing units. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces. Remove masking after repellent has cured.

3.4 FIELD QUALITY CONTROL

A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:

1. Owner will engage the services of a qualified testing agency to sample water-repellent material 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 of water-repellent material with product requirements.
3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect.

B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.

1. Notify Architect seven calendar days in advance of the dates and times when surfaces will be tested.
2. Reapply water repellent until coverage test indicates complete coverage.

C. Installer shall provide field quality control by staff having adequate prior experience and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

3.5 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 07 19 00

SECTION 07 1901 - WATER REPELLENTS - PARKING GARAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:

1. Division 07 Section, “Traffic Coatings (Parking Garage).”
2. Division 07 Section, “Water Repellents (Parking Garage).”
3. Division 07 Section, “Joint Sealants (Parking Garage).”
4. Division 07 Section, “Expansion Control (Parking Garage).”

B. This Section includes penetrating concrete sealer on these surfaces within open air areas only. Refer to section 07 1900 for enclosed areas.

1. Supported concrete floor and concrete roof surfaces including curbs, walks and islands.
2. Concrete stair treads and landings.
3. Slab-on-grade within parking facility, including curbs, walks, and islands.
4. Fire pump, domestic pump, electric and generator rooms.
5. Elevator and escalator pit floors.

C. Related Sections: Following Sections contain requirements that relate to this Section.

1. Division 03 Section, “Cast-in-Place Concrete (Parking Garage).”
2. Division 07 Section 07 1900 “Water Repellents” for requirements for enclosed spaces.
3. Division 07 Section, "Firestopping (Parking Garage)."
4. Division 07 Section, “Traffic Coatings (Parking Garage).”
5. Division 07 Section, “Joint Sealants (Parking Garage).”
6. Division 07 Section, “Expansion Control (Parking Garage).”
7. Division 09 Section, "Painting. (Parking Garage)."

1.3 REFERENCES

A. ASTM International (ASTM):

1. ASTM D6489, “Standard Test Method for Determining the Water Absorption of Hardened Concrete Treated with a Water Repellent Coating.”

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
2. Distribute reviewed submittals to all others whose Work is related.

B. Make submittals in accordance with requirements of Division 01 Section, “Shop Drawings, Product Data, and Samples~~Submittal Procedures~~:”

1. See requirements of Division 01 Section, "Shop Drawings, Product Data, and Samples~~Submittal Procedures~~," Part 1 heading, "Submittal Procedures," for limits to resubmittals.
2. See requirements of Division 01 Section, "Shop Drawings, Product Data, and Samples~~Submittal Procedures~~," Part 2 heading, "Requests for Information," for RFI constraints.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated at least 60 days prior to application.

1. Product description, technical data, appropriate applications, and limitations.
2. Areas and application rates of materials to be applied.
3. Proposed alternate application methods, if any.

B. Sustainable Design Documentation Submittals: Refer to section 01 8113.14 "Sustainable Design Requirements – LEED V4 BD+C".

1. Product Certificates:

a. Environmental Product Declarations (EPD's)

b. Corporate Sustainability Reporting (CSR's)

c. Health Product Declarations (HPD's)

1.6 INFORMATION SUBMITTALS

A. Certificates

1. Certification that products and installation comply with applicable federal, state of Florida, and local EPA, OSHA and VOC requirements regarding health and safety hazards and project LEED requirements.
2. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.

B. Field Quality Control

1. ASTM D6489 Test Results
2. Two copies of manufacturer's technical representative's log for each visit.

C. Qualification Statements

1. Manufacturer's qualifications as defined in the "Quality Assurance" article.
2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted system, to include:

a. Name and location of project.

b. Type of system applied.

c. On-Site contact with phone number.

B. Installer's Qualifications: Owner retains right to reject any installer.

1. Evidence of compliance with Summary article paragraph "A single installer. . ."
2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.

C. Testing Agency: Independent testing laboratory employed by Contractor and acceptable to Engineer/Architect.

D. Certifications

1. Licensing/certification document from system manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of Florida.
2. Licensing/certification agreement must provide following information:

a. Applicator's financial responsibility for warranty burden under agreement terms.

b. Manufacturer's financial responsibility for warranty burden under agreement terms.

c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.

d. Officers' signatures for both Applicator Company and Manufacturer.

e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. Do not store material on slabs to be post-tensioned before final post-tensioning of slabs is accomplished. At no time shall weight of stored material being placed on slab area, after post-tensioning is completed and concrete has reached specified 28-day strength, exceed total design load of slab area. Between time final post-tensioning is accomplished and time concrete has reached specified 28-day strength, weight of stored material placed on slab area shall not exceed half total design load of slab area.

1.9 FIELD CONDITIONS

A. Weather and Substrate Conditions: Do not proceed with application (except with written recommendation of manufacturer) under any of the following conditions:

1. Ambient temperature is less than 40º F.
2. Substrate surfaces have cured for less than 1 month.
3. Rain or temperatures below 40º F predicted for a period of 24 hours.
4. Less than 24 hours after surfaces became wet.
5. Substrate is frozen or surface temperature is less than 40º F.
6. Wind velocities higher than manufacturer's specified limit to prevent solvent flash-off.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of following, only where specifically named in product category:

1. Advanced Chemical Technologies Inc. (ACT), Oklahoma City, OK.
2. BASF Building Systems (BASF), Shakopee, MN.
3. Deneef Construction Chemicals (Deneef), Houston, TX.
4. Evonik Degussa Corporation (Evonik Degussa), Parsippany, NJ.
5. Euclid Chemical Company (Euclid), Cleveland, OH.
6. Lymtal International Inc. (Lymtal), Lake Orion, MI.
7. Prosoco, Inc. (Prosoco), Lawrence, KS
8. Sika Corporation (Sika), Lyndhurst, NJ.

2.2 MATERIALS, CONCRETE SEALER

A. Silane (90% or greater solids, 400 g/L or less VOC):

1. Hydrozo 100, 200 sf/g, BASF.
2. Iso-Flex 618-100 CRS, 200 sf/g, Lymtal.
3. Protectosil BHN, 200 sf/g, Evonik Degussa Corp.
4. Sikagard 705L ,200 sf/g, Sika.
5. Sil-Act ATS-100 LV, 200 sf/g, ACT.

B. Proposed substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

2.3 MATERIALS, CRACK SEALER

A. Repair for isolated random horizontal cracks 0.01 in. to 0.06 in. wide. Acceptable products for exterior application only:

1. SikaPronto 19TF, Sika.
2. Sikadur 55 SLV Epoxy Crack Healer/Sealer, Sika.
3. Degadeck, Crack Sealer Plus, BASF.
4. Denedeck Crack Sealer, Deneef.
5. Iso-Flex 609 Epoxy Crack Sealer, Lymtal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.

B. Coordinate and verify that related Work meets following requirements before beginning surface preparation and application:

1. Concrete surface finishes are acceptable for system to be installed.
2. Curing compounds used on concrete surfaces are compatible with system to be installed.
3. Concrete surfaces have completed proper curing period for system selected.
4. Control joint and expansion joint Work is complete and has been accepted by Engineer/Architect.

3.2 PREPARATION

A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

B. Acid etching is prohibited.

C. Repair or replace all sealant materials damaged by surface preparation operations.

D. Shot blast clean all surfaces to be sealed as acceptable to sealer manufacturer before sealer application. Shot blasting is not recommended or required for new slabs that are water cured per ACI 308, Paragraph 2.2. Cleaning method and materials shall be sufficient to allow absorption criteria stated in Field Quality Control article to be met. Prepare by sandblasting all surfaces inaccessible to shotblast equipment.

E. Equipment used during floor slab cleaning shall not exceed height limitation of facility and shall not exceed 3,000 lb axle load or vehicle gross weight of 6,000 lb.

F. Mask off adjoining surfaces not to receive sealer and mask off drains to prevent spillage and migration of liquid materials outside sealer area. Provide neat/straight lines at termination of sealer.

3.3 INSTALLATION/APPLICATION

A. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), coverage, mil thickness and texture, and as shown on Drawings.

B. Clean all surfaces affected by sealer material overspray and repair all damage caused by sealer material overspray to adjacent construction or property at no cost to Owner.

C. Clean off excess material as work progresses using methods and materials approved by manufacturer.

3.4 FIELD QUALITY CONTROL

A. Install 3 trial sections of sealer to verify treated surface is not glazing as result of sealer application. If application of sealer causes glazing at trial section, contact sealer manufacturer to obtain written recommendations for solving problem. Do not proceed with sealer application following trial section applications until directed to do so in writing by Engineer/Architect.

B. Testing Agency shall take a) 1 core from each trial section and b) 3 additional cores as directed by Engineer/Architect after sealer application to test for sealer effectiveness in accordance with ASTM D6489. Concrete core samples shall be taken 14 days after application of sealer. Report water absorption through top and bottom surfaces of core. Sealer shall reduce water absorption by at least 85 percent when compared with the unsealed bottom surface.

C. Installer shall provide weekly inspection log verifying all locations have been inspected and are free of installation defects or damage. Log should include specific locations and repairs performed. Log should be submitted to Contractor, Architect, Owner and BECxA.

3.5 NON-CONFORMING WORK

A. Unsatisfactory Field Quality Control test results shall be grounds for rejection of sealer or sealer application rate. Perform sealer reapplication at no additional cost to Owner.

END OF SECTION

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber blanket.
2. Mineral-wool board.
3. Foam-plastic board insulation.

B. Related Requirements:

1. Section 07 21 19 "Foamed-in-Place Insulation" for spray-applied polyurethane foam insulation.
2. Section 07 52 00 “SBS Modified Bituminous Membrane Roofing” for insulation specified as part of roofing construction.
3. Section 09 29 00 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: For Leadership Extraction Practices in the following:
   a. Extended Producer Responsibility
   b. Leadership Extraction Practices for Recycled Content
   c. Documentation on Low Emitting Materials.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.4 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.

PART 2 - PRODUCTS

2.1 POLYISOCYANURATE FOAM-PLASTIC BOARD

A. Polyisocyanurate Board, Foil Faced: ASTM C 1289, foil faced, Type I, Class 1 or 2.

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. Carlisle Coatings & Waterproofing Inc.

b. Dow Chemical Company (The).
c. Firestone Building Products.
d. Johns Manville.

2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 GLASS-FIBER BLANKET

A. Sustainability Requirements

1. Recycled Content: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional recycled content requirements.
2. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:
   a. Product specific declarations in accordance with ISO 1404
   b. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
   c. Industry Wide Product Specific Type III EPD Third Party Certification

B. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

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. CertainTeed Corporation; Sustainable Insulation.
   b. Johns Manville; a Berkshire Hathaway company; Formaldehyde Free Fiberglass Insulation.
   c. Knauf Insulation; EcoBatt Unfaced with ECOSE Technology.
   d. Owens Corning; EcoTouch PINK Fiberglas Insulation.

2.3 MINERAL-WOOL BOARD

A. Sustainability Requirements

1. Recycled Content: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent. Refer to Section 01 81 13.14 “SUSTAINABLE DESIGN REQUIREMENTS - LEED V4 BD+C” for additional recycled content requirements.
2. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:
   a. Product specific declarations in accordance with ISO 1404
   b. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
   c. Industry Wide Product Specific Type III EPD Third Party Certification

B. Mineral-Wool Board, Type III, Unfaced: ASTM C 612, Type III; with maximum flame-spread and smoke-developed indexes of 15 and zero, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics. Nominal density of 8 lb/cu. ft..

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Rock Wool Manufacturing Company; Delta 3 Mineral Wool Board

b. Roxul Inc; CAVITYROCK DD.
c. Thermafiber, Inc. an Owens Corning company; VersaBoard.

2.4 MINERAL-WOOL BLANKETS

A. Mineral-Wool Blanket, Unfaced: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Johns Manville; a Berkshire Hathaway company;MINWOOL
b. Knauf Insulation: KN Series
c. Thermafiber, Inc. an Owens Corning company; ULTRABATT

2.5 Sound Attenuation Batts

A. Recycled Content: Post-consumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent. Refer to Section 01 81 13.14 “SUSTAINABLE DESIGN REQUIREMENTS - LEED V4 BD+C” for additional recycled content requirements.

B. Type: Unfaced glass fiber acoustical insulation complying with ASTM C 665, Type I.

C. Size: 3½" x 16" x 96"

D. Surface Burning Characteristics (When tested in accordance with ASTM E 84):
1. Maximum flame spread: 10
2. Maximum smoke developed: 10

E. Combustion Characteristics:
1. Passes ASTM E 136.

F. Fire Resistance Ratings:
1. Passes ASTM E 119 as part of a complete fire tested wall assembly.

G. Sound Transmission Class: As indicated.

H. Dimensional Stability: Linear Shrinkage less than 0.1%

2.6 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. DiversiFoam Products.
b. Dow Chemical Company (The).
c. Kingspan Insulation.
d. Owens Corning.

2. Type V, 100 psi. for use as rigid insulation forms for cast-in-place concrete.
3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or 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.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

1. Refer to Section 01 35 46 “Indoor Air Quality” for additional requirements.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

A. 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 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, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Sound Attenuation Batts: 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. Support unfaced blankets with punched metal straps attached to the face of the framing, bent 90 degrees pointing into the stud cavity, and pushed into the insulation after installation.

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 Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..

3.4 INSTALLATION OF CURTAIN-WALL INSULATION

A. Install board insulation in curtain-wall construction according to curtain-wall manufacturer's written instructions.

1. Hold insulation in place by securing metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated on Drawings between insulation and glass.
2. Install insulation to fit snugly without bowing.

3.5 FIELD QUALITY CONTROL

A. Insulation installer shall provide field quality control by certified staff and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

B. Installer shall inspect all areas and confirm, in writing, that installation contains no gaps or other breaches.

3.6 PROTECTION

A. Protect installed insulation 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 07 21 00

SECTION 07 21 19 - FOAMED-IN-PLACE INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Closed-cell spray polyurethane foam.

B. Related Requirements:

1. Section 07 21 00 "Thermal Insulation" for foam-plastic board insulation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: For Leadership Extraction Practices in the following:
   a. Extended Producer Responsibility
   b. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Corporate Sustainability Reporting (CSR’s)
3. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Paints and Coatings
   b. Low Emitting Materials for Adhesives and Sealants

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Evaluation Reports: For spray-applied polyurethane foam-plastic insulation, from ICC-ES.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 CLOSED-CELL SPRAY POLYURETHANE FOAM

A. Closed-Cell Spray Polyurethane Foam: ASTM C 1029, Type II, minimum density of 1.5 lb/cu. ft. and minimum aged R-value at 1-inch thickness of 6.2 deg F x h x sq. ft./Btu at 75 deg F.

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. CertainTeed Corporation.
   b. Dow Chemical Company (The).
   c. Icynene Inc.
   d. Johns Manville; a Berkshire Hathaway company.
2. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   a. Flame-Spread Index: 25 or less.
   b. Smoke-Developed Index: 450 or less.
3. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 MISCELLANEOUS MATERIALS

A. Intumescent Coating: Coating recommended by insulation manufacturer to provide a thermal barrier complying with the Florida Building Code – Building Section 26 03 .4.

1. Provide at all locations where foamed-in-place insulation is installed without another approved thermal barrier.

B. Primer: Material recommended by insulation manufacturer where required for adhesion of insulation to substrates.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that substrates are clean, dry, and free of substances that are harmful to insulation.

B. Priming: Prime substrates where recommended by insulation manufacturer. Apply primer to comply with insulation manufacturer's written instructions. Confine primers to areas to be insulated; do not allow spillage or migration onto adjoining surfaces.

3.2 INSTALLATION

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

B. Spray insulation to envelop entire area to be insulated and fill voids.

C. Apply in multiple passes to not exceed maximum thicknesses recommended by manufacturer. Do not spray into rising foam.

D. Framed Construction: Install into cavities formed by framing members to achieve thickness indicated on Drawings.

E. Cavity Walls: Install into cavities to thickness indicated on Drawings.

F. Miscellaneous Voids: Apply according to manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

A. Insulation installer shall provide field quality control by certified staff and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

B. Installer shall inspect all areas and confirm, in writing, that installation contains no gaps or other breaches.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.

END OF SECTION 07 21 19

SECTION 07 24 23 - DIRECT-APPLIED FINISH SYSTEM

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Direct-Applied Finish System for soffits and ceilings.

1.3 DEFINITIONS

A. DEFS: Direct-applied exterior finish system(s).

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

C. Samples for Initial Selection: For each finish coat and for each color and texture specified.

D. Samples for Verification: For each finish coat and for each color and texture specified, 12 by 12 inches, and prepared on rigid backing.

1.6 QUALITY ASSURANCE

A. Manufacturer: A qualified manufacturer with no less than 10 years' experience in the manufacture of direct-applied finish systems.

B. Applicator: Approved by direct-applied finish system manufacturer to performing work of this section.

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

1. Build mockups for each substrate and finish texture indicated for direct-applied finish system, including accessories.

2. Refer to Section 01 43 39 “Visual Mock-Up Requirements” for additional requirements.
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. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit DEFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

1. Proceed with installation of adhesives or coatings only when ambient temperatures have remained, or are forecast to remain, above 40 deg F for a minimum of 24 hours before, during, and after application unless otherwise approved by the manufacturer in writing. Do not apply DEFS adhesives or coatings during rainfall.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver products in original packaging, labeled with product identification, manufacturer, and batch number.

B. Store products in a dry area with temperature maintained between 50 and 85 degrees F. Protect from direct sunlight. Protect from freezing. Protect from extreme heat (greater than 90 degrees F).

C. Handle products in accordance with manufacturer's written instructions.

1.9 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of DEFS assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Bond integrity and weathertightness.
b. Deterioration of DEFS finishes and other DEFS materials beyond normal weathering.

2. Warranty Period: Five years from date of Substantial Completion.

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. Dryvit Systems, Inc.
2. Parex USA, Inc.
3. Sto Corp.

B. Source Limitations: Obtain DEFS from single source from single manufacturer and from sources approved by manufacturer as compatible with DEFS components.

2.2 DEFS MATERIALS

A. Textured Finishes

1. High performance decorative and protective acrylic-based textured wall finish with integral color, complies with SCAQMD Rule 1113 for architectural finishes

B. Primer

1. Acrylic-based sanded primer complies with SCAQMD Rule 1113 for primers.

C. Base Coat

1. Sto BTS Plus – one component polymer modified portland cement high build base coat

D. Surface Reinforcement

1. Mesh – nominal 4.5 oz/yd^2 glass fiber reinforcing mesh treated for compatibility with DEFS materials.
2. Detail Mesh – nominal 4.2 oz/yd2 glass fiber reinforcing mesh treated for compatibility with DEFS materials.

E. Gypsum Sheathing

1. Glass-mat gypsum sheathing as specified in Section 06 16 00 “Sheathing”.

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 framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where DEFS will be installed.

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

1. Begin coating application only after surfaces are dry.
2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Protect contiguous work from moisture deterioration and soiling caused by application of DEFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.

B. Protect DEFS, substrates, and wall construction behind them from inclement weather during installation.

C. Prepare and clean substrates to comply with DEFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.

3.3 APPLICATION

A. Install corrosion proof termination accessories per ASTM D1784 (PVC) with perforated flanges for keying of the base coat at junctures with penetrations and with abutting walls and columns. Install corrosion proof control joints per ASTM D1784 (PVC) with perforated flanges for keying of the base coat at intervals as required by the soffit board manufacturer.

B. Reinforce perforated flanges of accessories with minimum 4 inch wide strips of Detail Mesh or Mesh embedded in base coat. Tape joints with minimum 4 inch wide Mesh or Detail mesh embedded in base coat. Allow base coat to dry.

C. Install base coat and mesh to the soffit/ceiling board surface according to manufacturer’s written instructions.

D. Apply the primer by brush or roller to the entire base coat surface.

E. Apply the textured finish by trowel. Apply finish in a continuous application, and work to a wet edge. Float the finish to achieve the desired texture.

3.4 CLEANING AND PROTECTION

A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive DEFS coatings.

END OF SECTION 07 24 23

SECTION 07 27 29 - AIR-BARRIER COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes vapor-retarding air-barrier coatings.

B. Related Requirements:

1. Section 06 16 00 "Sheathing" for wall sheathings and wall sheathing joint-and-penetration treatments.

1.2 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.
2. Air Barrier Coating manufacturer representative shall attend.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.

C. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Certificates: Provide the following:
   a. Corporate Sustainability Reporting (CSR’s)
   b. Health Product Declarations (HPD’s)

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Mockups for testing: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
   a. Coordinate construction of mockups to permit inspection by owners' testing agency of air barrier before external insulation and cladding are installed.
   b. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
   c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
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. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

C. Visual Mock-ups: additional mock-up shall be completed for visual inspection in accordance with Section 01 43 39 “Visual Mock-Up Requirements”.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.3 VAPOR-RETARDING, AIR-BARRIER COATING

A. Vapor-Retarding, Air-Barrier Coating: Synthetic polymer membrane.

1. Basis-of-Design Product: Subject to compliance with requirements, provide GCP Applied Technologies, Perm-A-barrier NPL 10 or a comparable, impermeable product by one of the following:
   a. Carlisle Coatings & Waterproofing Inc.
   b. Henry Company.
   c. Approved Substitution.
2. Performance Requirements
   a. Dry mill thickness not less than 40 mils.
   b. Water penetration resistance: joint treatment and primary air barrier and vapor barrier material, comply with ICC ES AC 212, par 4.8.3, no water penetration after 5 hours hydrostatic pressure
   c. Nail sealability: ASTM D 1970, 7.9.1, primary air barrier and vapor barrier passes
   d. Elongation: ASTM D 413, primary air barrier and vapor barrier material, > 500% at 7 days
   e. Adhesion: joint treatment and primary air barrier and vapor barrier material, ASTM D 4541, $\geq$ 35 psi, or exceeds strength of glass mat facing on glass mat gypsum substrates
   f. Surface burning: ASTM E 84, joint treatment and primary air barrier and vapor barrier material flame spread $\leq$ 25, smoke developed $\leq$ 450, Class A building material
   g. Water vapor permeance: ASTM E 96 Method A, < 0.1 perms

h. Material air leakage: ASTM D 2178, primary air barrier and vapor barrier and joint treatment < 0.0002 cfm/ft2 at 1.57 psf
i. Assembly air leakage: ASTM E 2357, $\leq$ 0.004 cfm/ft^2 air leakage after conditioning protocol
j. Field adhesion testing: ASTM D 4541, $\geq$ 35 psi (207 kPA) or exceeds strength of glass mat facing on glass mat gypsum substrates

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Butyl Strip: Vapor retarding, 30 to 40 mils thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.

D. Joint Reinforcing Strip: Air-barrier manufacturer's self-adhering glass-fiber-mesh tape.

E. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

F. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

G. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187-inch-thick, and Series 300 stainless-steel fasteners.

H. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

I. Modified Bituminous Transition Strip: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil-thick polyethylene film with release liner backing.

J. Joint Sealant: Single component, neutral curing, ultra-low modulus sealant compatible with air barrier coating and provided by air barrier coating manufacturer.

1. Basis of design product: GCP Applied Technologies, PAB S100.

K. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.

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

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of air-barrier coating material and embed joint reinforcing in preparation coat.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of air-barrier coating material at joints. Tape joints with joint reinforcing after first layer is dry. Apply a second layer of air-barrier coating material over joint reinforcing.

3.4 TRANSITION STRIP INSTALLATION

A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install modified bituminous transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.

B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

D. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply modified bituminous transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.

F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

H. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

I. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 AIR-BARRIER COATING INSTALLATION

A. General: Apply air-barrier coating to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply air-barrier coating within manufacturer's recommended application temperature ranges.

B. Air-Barrier Coatings: Apply a continuous unbroken air-barrier coating to substrates according to the following thickness. Apply an increased thickness of air-barrier coating in full contact around protrusions such as masonry ties.

1. Vapor-Retarding, Air-Barrier Coating: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, applied in two or more equal coats.
2. Apply additional coats as needed to achieve void- and pinhole-free surface.

C. Apply strip and transition strip a minimum of 1 inch onto cured air-barrier material or strip and transition strip over cured air-barrier material overlapping 3 inches onto each surface according to air-barrier manufacturer's written instructions.

D. Do not cover air barrier until it has been tested and inspected by Owner’s testing agency.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Construction Manager will engage a qualified testing agency to perform tests and inspections.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements.

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.

12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Air Barrier manufacturer shall make regularly scheduled site visits to inspect installation.

D. Tests: As determined by Owner's testing agency from among the following tests:

1. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, smoke pencil with pressurization or depressurization.
2. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.

E. Installer shall provide field quality control by staff having adequate prior experience and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

F. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

G. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 07 27 29

SECTION 07 41 10 – METAL CANOPY CLADDING SYSTEM

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 (including all sustainability requirements), apply to this Section.

B. Coordinate this work with all Contract Drawings and all other Sections of the Specifications for requirements therein affecting the work under this Section.

1.2 SUMMARY

A. Section includes formed custom canopy cladding of type and profile indicated over air/vapor barrier, sub-base underlayment and insulation and related flashing, trims and accessories.

1. Formed custom fabricated, mechanically attached, metal roof canopy panels of type and profile indicated over air/vapor barrier, sub-base underlayment and insulation and related flashing, trims and accessories for a weatherproof installation.
2. Formed custom fabricated, mechanically attached, metal soffit canopy panels of type and profile indicated, flashing, counterflashing and all related appurtenances.
3. Stainless steel gutters and downspouts as indicated on drawings.
4. Provide metal accessories and trim for all recessed light fixtures, speakers, etc.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide manufactured roof panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.

B. Air Infiltration: Provide manufactured roof panel assemblies with permanent resistance to air leakage through assembly of not more than 0.09 cfm/sq. ft. of fixed roof area when tested according to ASTM E 283 at a static-air-pressure difference of 4.0lbf/sq. ft.

C. Water Penetration: Provide manufactured roof panel assemblies with no water penetration as defined in the test method when tested according to ASTM E 331 at a minimum differential pressure of 20 percent of inward acting, wind-load design pressure of not less than 6.24 lb/sq. ft. and not more than 12.0 lb/sq. ft.

D. Wind-Uplift Resistance: Provide roof panel assemblies that meet requirements of UL 580 for Class 90 wind-uplift resistance and the Florida Building Code 5th edition (2014), and in accordance with the 2014 Florida Test Protocols.

E. Structural Performance: Provide manufactured canopy panel composite assemblies which are capable of withstanding design loads indicated under in-service conditions as established by ASCE 7-05 analysis with vertical deflection no greater than the following when tested in accordance with ASTM E 330:

1. Maximum Deflection: L/175 of the span.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review canopy panel requirements and installation, special details, mockups, air-leakage and bond testing, protection, and work scheduling.
2. Canopy panel manufacturer representative shall attend.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's product specifications, standard details, certified product test results, and installation instructions, as applicable to materials and finishes for each component and for complete, single-source metal panel system.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 "Sustainable Design Requirements – LEED V4 BD+C".

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD's)

C. Florida Product Approval: Provide documentation of product approval from the Florida Department of Business & Professional Regulation Florida Product Approval. A Notice of Acceptance (NOA) from Miami Dade County is preferred over a Florida State Product Approval.

D. Shop Drawings: Show layouts of panels on roof, details of edge conditions, joints, panel profiles, supports, anchorage, trim, flashing, underlayment, closures, gutters, expansion joints, and special details. Distinguish between factory and field-assembled work.

E. Samples for Verification: Provide sample panels 12 inches long by actual panel width, in the style, color, and texture indicated. Include clips, caps, battens, fasteners, closures, and other exposed panel accessories.

F. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include manufacturer's certification of qualifications, lists of completed projects with project names and addresses, names and addresses of project architects and owners, and any other information necessary to verify qualifications.

G. Product Test Reports: Indicate compliance of canopy panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.

H. Mockups: Build mockups as indicated in Section 01 43 39 “Visual Mock-up Requirements”.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Provide material cleaning instructions and recommendation to be included in Operations and Maintenance Manuals.

J. For installed products indicated to comply with certain design loading, include structural analysis data prepared in accordance with ASCE 7-05, signed and sealed by a licensed professional engineer.

1.6 QUALITY ASSURANCE

A. Qualifications of Manufacturer: Manufacturer must also have a minimum of ten (10) years’ experience in the manufacture of custom architectural sheet metal systems.

B. Manufacturer’s On-site Representation: Provide a manufacturer’s representative to provide part-time inspection of canopy system installation. Submit construction/installation progress reports and a final inspection report to the Owner’s Authorized Representative and the Architect.

C. Installer Qualifications: Installer shall be certified by the manufacturer. The installer shall have completed metal roof panel projects similar in material, design, and extent to that indicated for this Project and have a documented record of successful in-service performance.

D. Professional Engineer Qualifications: A professional engineer who is legally licensed to practice in the jurisdiction where the Project is located.

E. Single-Source: Utilize coil/sheet produced by one manufacturer. Provide roof and soffit panels, flashing, and gutter profiles fabricated from material of a single sheet metal manufacturer. Award installation of waterproofing underlayment and metal canopy system to a single firm for undivided responsibility; including fabrication, erection and finishes.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver panels and other components so they will not be damaged or deformed. Package panels for protection against damage during transportation or handling.

B. Handling: Exercise care in unloading, storing, and erecting roof panels to prevent bending, warping, twisting, and surface damage.

C. Stack material on platforms or pallets, covered with tarpaulins or other suitable weather-tight and ventilated covering. Store panels to ensure dryness. Do not store

panels on contact with other materials that might cause staining, denting, or other surface damage.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify location of structural members and openings in substrates by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1. Established Dimensions: Take accurate field measurements before panels are made without delaying the work, establish dimensions and proceed with fabricating panels. Without field measurements product will be fabricated in accordance with dimensions noted on approved shop drawings. Coordinate canopy construction to ensure actual locations of structural members and to ensure opening dimensions correspond to established dimensions.

1.9 WARRANTY

A. General Warranty: Special warranties specified in the Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Document.

B. Special Warranty: Submit a written, signed warranty covering failure of the factory-applied exterior paint finish on metal canopy panels within the specified warranty period and agreeing to repair finish or replace canopy panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.

1. Paint Finish Warranty Period: 20 years from date of Substantial Completion.
2. Special Weather-tight Warranty: Submit a written single-source warranty, executed by the roofing system manufacturer agreeing to repair or replace the metal roof panel assembly that fails to remain weather-tight within the specified warranty period. The 20-year Weather-tight Warranty shall include all flashing, canopy panels, and all other metal system components.

PART 2 - PRODUCTS

2.1 METAL PANEL CANOPY SYSTEM

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 45 00 “Quality Control”, to design canopy cladding system.

B. Provide products that comply with the Florida Product Approval Standards and the System SHALL obtain a valid and current Notice of Acceptance by the State or Miami Dade County A one-time Product Approval from Miami Dade County Office of Code Compliance is acceptable. An approved NOA shall be submitted prior fabrication or installation of any component,

C. Flat, batten free, internal draining metal canopy system consisting of the following:

1. Gutter System: Provide continuous 16 gage stainless steel gutter system with welded/soldered seams and expansion joints.
2. Movement: Provide for independent movement of all roof components consistent with a thermal range of 120 degrees F and consistent with anticipated movement of building structure.
3. Replacement of Panels and Drainage Components: Provide for non-destructive removal and replacement of individual roof panels and drainage components.
4. Concealed fasteners.
5. Infill board: Provide manufacturer's standard infill board to reduce metal panel warping with a compressive strength not less than 20 psi.

D. 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. A. Zahner Co.
2. CSI Architectural Metal, Inc.
3. Overly Mfg. Company

2.2 METALS AND FINISHES

A. Sheets: Aluminum 18 gauge (0.040 inches) 3003-H14 alloy.

1. Panel Finish: 2-coat Kynar 500 PVDF, color as selected by Architect from manufacturer's full line.
2. Panel Infill Board, factory applied to the underside of all panels, is required. Material shall be un-faced, pre-formed, rigid, cellular, polyisocyanurate thermal insulation complying with ASTM C 591, Type 2, thermal-resistance values for 1-inch thickness of 6.2 degrees F x h x sq. ft./Btu at 75 degrees F.
3. Recycled Content of Aluminum Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
   a. Refer to Section 01 81 13.14 "Sustainable Design Requirements - LEED v4 BD+C" for additional information and requirements for recycled content.

B. Fasteners: System fasteners shall be concealed and no less than a #12 stainless steel screw shall be used to anchor the internal drain channel; length as required for substrate construction.

2.3 ROOF UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 40 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. GCP Applied Technologies
b. Mid-States Asphalt Quick Stick HT Pro
c. Polyglass Polystick MTS
d. Soprema Lastobond Shield HT
e. Tamko TW Underlayment or TW Metal & Tile Underlayment

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and accessories required for a complete canopy panel assembly and as recommended by panel manufacturer, unless otherwise indicated.

B. Accessories: Unless otherwise specified, provide components required for a complete canopy panel assembly including trim, copings, fascia, mullions, sills, corner units, ridge closures, clips, seam covers, flashing, gutters, sealants, gaskets, fillers, closure strips, and similar items. Match materials and finishes of canopy panels.

C. Fasteners: Type tested and approved to secure roof panel system in accordance with UL and uplift requirements.

D. Paper Slip Sheet: 5-lb/square red rosin, sized building paper conforming to FS UU-B-790, Type 1, Style 1b.

E. Continuous Soffit Vents: Aluminum louvered construction.

1. Basis of Design: GAF, LSV8 Series or approved equal.
2. Style: Hat-shaped
3. Length: 8-foot minimum length
4. Opening: As indicated.

2.5 FABRICATION

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

B. Fabricate metal canopy system components to allow for expansion in running work sufficient to prevent leakage, damage, and deterioration of the Work. Form exposed sheet metal work to fit substrates without excessive oil canning, buckling, and tool marks, true to line and levels indicated, and with exposed edges folded back to form hems.

C. Form and fabricate sheets, seams, strips, cleats, edge treatments, integral flashing, and other components of metal roofing to profiles, patterns, and drainage arrangements shown and as required to resist water infiltration without excessive use of sealants (dry Joints) while also allowing any water infiltration behind the roof panels to weep out

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements indicated for conditions affecting performance of metal panel roofing.

1. Panel Supports and Anchorage: Examine canopy framing to verify that purlins, angles, channels, and other secondary structural panel support members and anchorage have been installed according to written instructions of manufacturer.
2. Do not proceed with canopy panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate metal panel roofing with rain drainage work; flashing; trim; and construction of decks, parapets, walls, and other adjoining work to provide a leak-proof, secure, and non-corrosive installation.

B. Promptly remove protective film, if any, from exposed surfaces of metal panels. Strip with care to avoid damage to finish.

3.3 INSTALLATION

A. General: Comply with panel manufacturer's written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the work securely in place, with provisions for thermal and structural movement.

1. Field cutting exterior panels by torch is not permitted.
2. Install panels with approved fasteners.
3. Install plywood substrate, underlayment, and slip sheet material in accordance with material manufacturer's instructions and recommendations.

B. Accessories: Install components required for a complete roof panel as assembly including trim, copings, fascia, ridge closures, clips, seam covers, battens, flashings, gutters, sealants, gaskets, fillers, closure strips, and similar items.

C. Installation Tolerances: Shim and align panel units within installed tolerance of 3/8 inch in 40-foot slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.4 FIELD QUALITY CONTROL

A. Installer shall provide field quality control by staff having adequate prior experience and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
2.
    a. BECxA Checklists shall include specific locations of the work and specific location and description of any repairs.

b. BECxA checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.

3. Provide field inspection reports within 5 working days of inspection.

3.5 FIELD TESTING

A. Conduct 10 random fastener pull tests in accordance with this section in areas designed by the Owner's Authorized Representative, and submit test results for the comparison to design requirements.

B. Block gutter drains and fill with water. Let stand for 24 hours. Repair gutter as required and retest until gutters are watertight.

3.6 CLEANING AND PROTECTING

A. Damaged Units: Replace panels and other components of the work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

1. Refer to Section 01 74 23 "Final Cleaning" for additional requirements.

C. Protection: Do not permit unnecessary walking on finished roof. Require all personnel to wear rubber-soled shoes when walking on or installing this roof system.

END OF SECTION 07 41 10

SECTION 07 41 13.16 - STANDING-SEAM METAL ROOF PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes standing-seam metal roof panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

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

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

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

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Refer to Section 01 43 39 “Visual Mock-Up Requirements” for additional requirements.
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.

1.7 DELIVERY, STORAGE, AND HANDLING

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

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

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

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

1.8 FIELD CONDITIONS

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

1.9 COORDINATION

A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.
2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 or ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

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

1. Uplift Rating: UL 90.

E. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.

1. Fire/Windstorm Classification: Class 1A- 90.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

B. Vertical-Rib, ~~Seam Cap~~ Seamed Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips

located under one side of the panels, ~~aligning vertical ribs and seaming on seam cap~~ engaging opposite edge of adjacent panels, and mechanically seaming panels together .

1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing Company; ~~Tee-Lock~~ Zee-Lock or comparable product by one of the following:
   a. IMETCO.
   b. McElroy Metal, Inc.
2. Metallic-Coated Steel Sheet: Aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
   a. Nominal Thickness: 0.024 inch
   b. Exterior Finish: Two-coat fluoropolymer.
   c. Painted materials shall have a removable plastic film to protect the paint during roll forming, shipping and handling.
   d. Color: As selected by Architect from manufacturer's full range.
3. Clips: ~~Tee-Lock Clip~~ Zee-Clip to accommodate thermal movement.
   a. Material: ~~0.064-inch~~ 0.024 inch nominal thickness, aluminum-zinc alloy-coated steel sheet.
4. Panel Coverage: 15 inches.
5. Panel Height: 2.375 inches.
6. Joint Type: Single folded.
7. Panel Coverage: 16 inches.
8. Panel Height: 2.0 inches.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 40 mils thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: Stable after testing at 240 deg F; ASTM D 1970.
2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F; ASTM D 1970.
3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Mid-States Asphalt Quick Stick HT Pro
   b. Polyglass Polystick MTS
   c. Soprema Lastobond Shield HT
   d. Tamko TW Underlayment or TW Metal & Tile Underlayment

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch-long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 36 inches o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.

E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot-long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.

F. Panel Fasteners: Self-tapping screws designed to withstand design loads.

G. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Joint Sealant: Silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

2.5 FABRICATION

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

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

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

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
3. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

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

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

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

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

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

1. Apply over the entire roof surface.

B. Flashings: Install flashings to cover underlayment to comply with requirements specified in Section 07 62 00 "Sheet Metal Flashing and Trim."

3.4 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Locate and space fastenings in uniform vertical and horizontal alignment.
4. Install flashing and trim as metal panel work proceeds.
5. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
6. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

1. Install clips to supports with self-tapping fasteners.
2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.

I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c. in between.

1. Connect downspouts to underground drainage system indicated.

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

3.5 ERECTION TOLERANCES

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

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.

B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.

C. Testing Agency: Employ and pay a qualified independent testing agency to perform field quality control, including infrared inspections on installed roof assemblies. Materials and installation failing to meet specified requirements shall be replaced at Contractor's expense. Retesting of materials and installations failing to meet specified requirements shall be done at Contractor’s expense.

~~1. Infrared Inspection: Where infrared survey indicates moisture intrusion, wet insulate on and damaged or deficient materials or construction shall be replaced in a manner to provide watertight and specified wind uplift resistant construction, and maintain the roof system warranty.~~

D. Installer shall provide field quality control by staff having adequate prior experience and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.

3.7 CLEANING AND PROTECTION

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

B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 41 13.16

SECTION 07 42 13.13 - FORMED METAL WALL PANELS

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exposed-fastener, lap-seam metal wall panels.

B. Related Sections:

1. Section 07 42 13.23 "Metal Composite Material Wall Panels" for metal-faced composite wall panels.
2. Section 07 42 93 "Soffit Panels" for metal panels used in horizontal soffit applications.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review of procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

1.5 ACTION SUBMITTALS

A. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.

1. Include Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

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

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

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

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

1.10 FIELD CONDITIONS

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

1.11 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

F. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

A. General: Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to

supports using exposed fasteners in side laps. Include accessories required for weathertight installation.

B. Tapered-Rib-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal major ribs and a flat pan between major ribs.

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. Berridge Manufacturing Company.
b. CENTRIA Architectural Systems.
c. Firestone Building Products.
d. McElroy Metal, Inc.

~~2. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.~~

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

a. Thickness: Not less than 0.032 inch.
b. Surface: Smooth, flat finish.
c. Exterior Finish: Two-coat fluoropolymer.
d. Color: As selected by Architect from manufacturer's full range.

3. Major-Rib Spacing: ~~6~~ 7.2 inches o.c.
4. Panel Coverage: 36 inches.
5. Panel Height: ~~0.75~~1-1/2 inch.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.

3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

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. GCP Applied Technologies Inc. (formerly Grace Construction Products); Grace Ice and Water Shield HT.
   b. Henry Company; Blueskin PE200 HT.
   c. Polyguard Products, Inc.; Deck Guard HT.

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

2.5 FABRICATION

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

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

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

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

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.6 FINISHES

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

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in 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.

C. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

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

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.

4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel

manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test 100 square foot area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Installer shall provide field quality control by certified staff and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

3.5 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation

instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13.13

SECTION 07 42 13.19 - INSULATED METAL WALL PANELS

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. Foamed-insulation-core horizontal and vertical metal wall panel assembly with integral reveals and profiled panels, with related metal trim and accessories.

B. Related Requirements:

1. Section 05 40 00 “Cold-Formed Metal Framing” for support framing for insulated core metal wall panels.
2. Section 07 27 29 “Air-Barrier Coatings” for transition and flashing components of air/moisture barrier.
3. Section 07 62 00 “Sheet Metal Flashing and Trim” for sheet metal copings, flashings, reglets and roof drainage items.
4. Section 07 92 00 “Joint Sealants” for field-applied joint sealants.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal panel Installer, metal panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal panel assembly during and after installation.
8. Review procedures for repair of metal panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Health Product Declarations (HPD’s)

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish, prepared on Samples of size indicated below.

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For special warranties.

E. Florida Product Approval

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Refer to Section 01 43 39 “Visual Mock-Up Requirements” for additional requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

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

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

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

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

1.9 FIELD CONDITIONS

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

1.10 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

B. Health Product Declaration: Provide Health Product Declaration (HPD) with full disclosure of known hazards in compliance with the Health Product Declaration Open Standard

C. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

D. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 72:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

E. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft..

F. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 15 lbf/sq. ft..

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

H. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E 119.
2. Intermediate-Scale Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which wall panel is a part, complies with NFPA 285 for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies.
3. Radiant Heat Exposure: No ignition when tested according to NFPA 268.
4. Potential Heat: Acceptable level when tested according to NFPA 259.
5. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E 84.

2.2 FOAMED-INSULATION-CORE METAL WALL PANELS

A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.

1. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.

a. Closed-Cell Content: 90 percent when tested according to ASTM D 6226.
b. Density: 1.3 to 2.6 lb/cu. ft. when tested according to ASTM D 1622.
c. Compressive Strength: Minimum 20 psi when tested according to ASTM D 1621.
d. Shear Strength: 26 psi when tested according to ASTM C 273/C 273M.

B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking

panel edges and mechanically attaching panels to supports using concealed clips or fasteners.

1. Basis-of-Design Product: Subject to compliance with requirements, provide CENTRIA Architectural Systems; Formawall Dimension Series or a comparable product by one of the following:

   a. Kingspan Insulated Panels.
   b. Metl-Span.

2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

   a. Nominal Thickness: 0.034 inch.
   b. Exterior Finish: Three-coat fluoropolymer.

      1) Color: Match Architect's samples.

   c. Interior Finish: 0.2 mil primer with 0.6 mil acrylic color coat.
3. Panel Coverage: [**36 inches**] [**40 inches**] <**Insert dimension**> nominal.
4. Panel Thickness: [**1.0 inch**] [**1.5 inches**] [**2.0 inches**] [**2.5 inches**] [**3.0 inches**] [**4.0 inches**] [**5.0 inches**] <**Insert dimension**>.
5. Thermal-Resistance Value (R-Value): <**Insert R-value**> according to ASTM C 1363.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Backer Board: Hardboard complying with ANSI A135.4, Class 1 tempered, 1/8 inch thick unless otherwise indicated.

D. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

E. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

F. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.4 FABRICATION

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

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

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

D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

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

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in 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.

C. Steel Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 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.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

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

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
2. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types

of gaskets, fillers, and sealants indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal wall panel manufacturer.

1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

3.4 INSULATED METAL WALL PANEL INSTALLATION

A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.

1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.
7. Apply snap-on battens to exposed-fastener, insulated-core metal wall panel seams to conceal fasteners.

B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.

1. Install clips to supports with self-tapping fasteners.

C. Laminated-Insulation-Core Metal Wall Panels:

1. Wrapped-Edge Panels: Mechanically attach wall panels to supports using staggered, concealed side clips engaging wrapped panel edges. Install clips to supports with self-tapping fasteners. Seal joints with manufacturer's standard gaskets.
2. Wrapped-Edge Panels: Mechanically attach wall panels through extended edge of panels to supports using self-tapping fasteners. Seal joints with manufacturer's standard gaskets.

3. Shiplap-Edge Panels: Mechanically attach wall panels to supports using staggered, concealed side clips engaging tongue-and-groove panel edges. Install clips to supports with self-tapping fasteners.

   a. Horizontal Joints: Maintain reveal joint of consistent width.
   b. Vertical Joints: Maintain reveal joint of consistent width.

4. Framed-Edge Panels: Mechanically attach wall panels through integral, extruded edge members to supports using self-tapping fasteners. Seal joints with manufacturer's standard gaskets.

D. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

E. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Metal wall panels will be considered defective if they do not pass test and inspections.

E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Installer shall provide field quality control by certified staff and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

3.6 CLEANING AND PROTECTION

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

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 13.19

SECTION 07 42 13.23 - METAL COMPOSITE MATERIAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal composite material wall panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, metal composite material panel manufacturer's representative, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
8. Review procedures for repair of panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Shop Drawings:

1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages,

attachment assembly, trim, flashings, closures, accessories, weeps, and special details.

2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Initial Selection: For each type of metal composite material panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Composite Material Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Florida Product Approval.

D. Field quality-control reports.

E. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal composite material panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups as indicated in Section 01 43 39 “Visual Mock-up Requirements”.

1. Build mockup of typical metal composite material panel assembly, including corner, soffits, supports, attachments, and accessories.
2. Water-Spray Test: Conduct water-spray test as indicated in Section 01 91 15 “Exterior Enclosure Commissioning”.
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. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

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

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

C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal composite material panels during installation.

1.8 FIELD CONDITIONS

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

1.9 COORDINATION

A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal composite material panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.
2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal composite material panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft.

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 6.24 lbf/sq. ft.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Fire Propagation Characteristics: Metal composite material wall panel system passes NFPA 285 testing.

2.2 METAL COMPOSITE MATERIAL WALL PANELS

A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.

1. Basis-of-Design Product: Subject to compliance with requirements, provide 3A Composites USA, Inc., ALUCOBOND or a comparable product by one of the following:
   a. CENTRIA Architectural Systems.
   b. Firestone Metal Products, LLC.

B. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 50 percent.

1. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

C. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

D. Aluminum-Faced Composite Wall Panels ACM-1: Formed with 0.020-inch-thick, coil-coated aluminum sheet facings.

1. Panel Thickness: 6 mm.
2. Core: Standard.
3. Exterior Finish: Three-coat fluoropolymer.
   a. Color: As selected by Architect from manufacturer's full range.

E. Aluminum-Faced Composite Wall Panels ACM-2: Formed with 0.020-inch-thick, coil-coated aluminum sheet facings.

1. Panel Thickness: 4 mm.
2. Core: Standard.
3. Exterior Finish: Three-coat fluoropolymer.
   a. Color: As selected by Architect from manufacturer's full range.

F. Attachment Assembly Components: Formed from material compatible with panel facing.

G. Attachment Assembly: Manufacturer's standard.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by

means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Sealants and gaskets within the panel system shall be as per manufacturer's standards to meet performance requirements.

2.4 FABRICATION

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

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

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

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

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in 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.

C. Aluminum Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.
   a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.

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

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal composite material panels.
2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
3. Install screw fasteners in predrilled holes.

4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal composite material panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
2. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.

C. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

D. Installation: Attach metal composite material wall panels to supports at locations, spacings, and with fasteners recommended by manufacturer to achieve performance requirements specified.

1. Wet Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 07 92 00 "Joint Sealants."
2. Dry Seal Systems: Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gasket system.
3. Rainscreen Systems: Do not apply sealants to joints unless otherwise indicated.

E. Clip Installation: Attach panel clips to supports at locations, spacings, and with fasteners recommended by manufacturer. Attach routed-and-returned flanges of wall panels to panel clips with manufacturer's standard fasteners.

1. Seal horizontal and vertical joints between adjacent panels with sealant backing and sealant. Install sealant backing and sealant according to requirements specified in Section 07 92 00 "Joint Sealants."
2. Seal horizontal and vertical joints between adjacent metal composite material wall panels with manufacturer's standard gaskets.

F. Rainscreen-Principle Installation: Install using manufacturer's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal

composite material wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.

1. Install wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.
2. Do not apply sealants to joints unless otherwise indicated.

G. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.

H. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Contractor will engage a qualified independent testing agency to perform field tests and inspections.

B. Water-Spray Test: After installation, test 100 square foot area of assembly in mock-up for water penetration according to AAMA 501.2.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed metal composite material wall panel installation, including accessories.

D. Metal composite material wall panels will be considered defective if they do not pass test and inspections.

1. Test specimen failing shall be repaired or replaced.
2. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

E. Installer shall provide field quality control by staff having adequate prior experience and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provideweekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

3.6 CLEANING AND PROTECTION

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

B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

D. Refer to Section 01 74 23 “Final Cleaning” for additional requirements.

END OF SECTION 07 42 13.23

SECTION 07 42 93 - SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes metal soffit panels.

B. Related Sections:

1. Section 07 41 13.13 "Formed Metal Roof Panels" for lap-seam metal roof panels.
2. Section 07 42 13.23 “Metal Composite Material Wall Panels” for metal wall panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: For Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Corporate Sustainability Reporting (CSR’s)

C. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
2. Accessories: Include details of flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Metal Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal panel accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each product, tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

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

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Refer to Section 01 43 39 “Visual Mock-up Requirements” for mock-up requirements.
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. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

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

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

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

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

1.8 FIELD CONDITIONS

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

1.9 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of walls, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including rupturing, cracking, or puncturing.
b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sustainability Requirements

1. Recycled Content of Steel Products: Post-consumer recycled content plus one-half of pre consumer recycled content not less than 29 percent.
2. Environmental Product Declarations (EPD’s)
3. Corporate Sustainability Reporting (CSR’s)

B. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

C. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft..

D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft..

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METAL SOFFIT PANELS

A. General: Provide metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps. Include accessories required for weathertight installation.

B. Metal Soffit Panels: Match profile and material of metal wall panels.

1. Finish: Match finish and color of metal wall panels.
2. Sealant: Factory applied within interlocking joint.

C. Solid Flush-Profile Metal Soffit Panels: Solid panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing Company; FW-12 (with two grooves) or a comparable product by one of the following:

   a. CENTRIA Architectural Systems.
   b. Firestone Building Products.

2. Material: Same material, finish, and color as metal wall panels.

3. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch.
    b. Surface: Smooth, flat finish.
    c. Exterior Finish: Three-coat fluoropolymer.
    d. Color: Match Architect's samples.

4. Panel Coverage: 12 inches.
5. Panel Height: 1.5 inches.

D. Perforated Flush-Profile Metal Soffit Panels: Perforated panels formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced between panel edges; with flush joint between panels.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing Company; FW-12 (with two grooves) or a comparable product by one of the following:

    a. CENTRIA Architectural Systems.
    b. Firestone Building Products.

2. Material: Same material, finish, and color as metal wall panels.

3. Aluminum Sheet: Coil-coated sheet, ASTM B 209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

    a. Thickness: 0.032 inch.
    b. Surface: Smooth, flat finish.
    c. Exterior Finish: Three-coat fluoropolymer.
    d. Color: Match Architect's samples.

4. Panel Coverage: 12 inches.
5. Panel Height: 1.5 inches.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

1. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant types recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
2. Joint Sealant: ASTM C 920; silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

2.4 FABRICATION

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

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

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

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

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal soffit panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

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

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in 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.

C. Aluminum Panels and Accessories:

1. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 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.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Examine framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal panel manufacturer.
2. Examine sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal panel manufacturer.

a. Verify that air- or water-resistive barriers been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

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

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

1. Soffit Framing: Wire tie or clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal panels.
2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels and elsewhere as needed to make panels watertight.

2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

F. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling, and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to achieve waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be waterproof, form expansion joints of intermeshing hooked flanges, not less than 1-inch-deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

A. Installer shall provide field quality control by staff having adequate prior experience and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

3.5 CLEANING AND PROTECTION

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

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 42 93

SECTION 07 54 19 - POLYVINYL-CHLORIDE (PVC) ROOFING

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Adhered polyvinyl chloride (PVC) roofing system.
2. Substrate board.
3. Vapor retarder.
4. Roof insulation.
5. Cover board.
6. Walkways.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 07 71 29 "Manufactured Roof Expansion Joints" for premanufactured roof expansion-joint assemblies.
4. Section 07 92 00 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
5. Section 22 14 23 "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing Manual: Membrane Roof Systems" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review deck substrate requirements for conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

B. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Construction Manager, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, air barrier Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that affects roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For insulation and roof system component fasteners, include copy of FM Approvals' RoofNav listing.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.
2. Base flashings and membrane terminations.

3. Flashing details at penetrations.
4. Tapered insulation thickness and slopes.
5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Tie-in with air barrier.

C. Samples for Verification: For the following products:

1. Roof membrane and flashing, of color required.
2. Walkway pads or rolls, of color required.

D. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of compliance with performance requirements.

2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

C. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.

D. Evaluation Reports: For components of roofing system, from ICC-ES.

E. Field Test Reports:

1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.

F. Field quality-control reports.

G. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

B. Certified statement from existing roof membrane manufacturer stating that existing roof warranty has not been affected by Work performed under this Section.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is listed in FM Approvals' RoofNav for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, 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 roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, substrate board, and other components of roofing system.
2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, roof

insulation, fasteners, cover boards, substrate boards, vapor retarders, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roof system and flashings shall remain watertight.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Wind Uplift Resistance: Design roofing system to resist the following wind uplift pressures when tested according to FM Approvals 4474, UL 580, or UL 1897.

D. FM Approvals' RoofNav Listing: Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.

1. Fire/Windstorm Classification: Class 1A-90.

E. Solar Reflectance Index: ASTM E1980; for low-slope roofs, SRI greater than or equal to 82 or a 3-year aged SRI greater than or equal to 64.

F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

G. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.2 POLYVINYL CHLORIDE (PVC) ROOFING

A. PVC Sheet: ASTM D 4434/D 4434M, Type III, fabric reinforced and fabric backed.

1. Basis-of-Design Product: Subject to compliance with requirements, provide SOPREMA; SENTINEL PVC P200 HFB or a comparable product by one of the following:

a. Carlisle SynTec Incorporated.
b. GAF.

c. Johns Manville; a Berkshire Hathaway company.

2. Membrane Thickness: 80 mils.

3. Exposed Face Color: White.

B. Source Limitations: Obtain components for roofing system from roof membrane manufacturer or manufacturers approved by roof membrane manufacturer.

2.3 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.

1. Adhesives and Sealants: Comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.

C. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.

D. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.

E. Slip Sheet: Manufacturer's standard, of thickness required for application.

F. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

G. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.

I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

2.4 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1396/C 1396M, Type X gypsum board.

1. Thickness: 5/8 inch.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

2.5 VAPOR RETARDER

A. Self-Adhering-Sheet Vapor Retarder: ASTM D 1970/D 1970M, polyethylene film laminated to layer of rubberized asphalt adhesive, minimum 40-mil-total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor retarder manufacturer.

2.6 ROOF INSULATION

A. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2, felt or glass-fiber mat facer on both major surfaces manufactured or approved by PVC roof membrane manufacturer, approved for use in FM Approvals' RoofNav listed roof insulation.

1. Compressive Strength: 20 psi.
2. Size: 48 by 48 inches.
3. Thickness:

    a. Base Layer: 1-1/2 inches.
    b. Upper Layer: As required to meet thermal resistance requirements.

B. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: 1/4 inch.
3. Slope:

    a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
    b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

2.7 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with other roofing system components.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.

D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum board or ASTM C 1278/C 1278M fiber-reinforced gypsum board.

1. Thickness: 5/8 inch.
2. Surface Finish: Unprimed.

E. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

2.8 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 1/8 inch thick and acceptable to roofing system manufacturer.

1. Size: Approximately 36 by 60 inches.
2. Color: Contrasting with roof membrane.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 31 00 "Steel Decking."

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

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing system installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Perform fastener-pullout tests according to roof system manufacturer's written instructions.

1. Submit test result within 24 hours of performing tests.

a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions, FM Approvals' RoofNav assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Coordinate installation and transition of roofing system component serving as an air barrier with air barrier specified under Section 07 27 29 "Air Barrier Coatings."

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inchesin adjacent rows.

1. At steel roof decks, install substrate board at right angle to flutes of deck.

a. Locate end joints over crests of steel roof deck.

2. Tightly butt substrate boards together.
3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
4. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 VAPOR RETARDER INSTALLATION

A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 and 6 inches, respectively.

1. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
2. Seal laps by rolling.

B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into roofing system.

3.6 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Installation Over Metal Decking:

1. Install base layer of insulation with joints staggered not less than 24 inches in adjacent rows.
   a. Locate end joints over crests of decking.
   b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
   d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.

      1) Trim insulation so that water flow is unrestricted.

   e. Fill gaps exceeding 1/4 inch with insulation.
   f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
   g. Mechanically attach base layer of insulation and substrate board using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to metal decks.

      1) Fasten insulation according to requirements in FM Approvals' RoofNav for specified Windstorm Resistance Classification.
      2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.

2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.

   a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
   b. Install with long joints continuous and with end joints staggered not less than 12 inches in adjacent rows.
   c. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
   d. Make joints between adjacent insulation boards not more than 1/4 inch in width.
   e. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
   f. Trim insulation so that water flow is unrestricted.
   g. Fill gaps exceeding 1/4 inch with insulation.
   h. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
   i. Adhere each layer of insulation to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:

1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.7 INSTALLATION OF COVER BOARDS

A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.

1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
2. At internal roof drains, conform to slope of drain sump.

a. Trim cover board so that water flow is unrestricted.

3. Cut and fit cover board tight to nailers, projections, and penetrations.
4. Adhere cover board to substrate using adhesive according to FM Approvals' RoofNav assembly requirements and FM Global Property Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification, as follows:
   a. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

B. Install slip sheet over cover board and immediately beneath roof membrane.

3.8 ADHERED ROOFING INSTALLATION

A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.

B. Unroll roof membrane and allow to relax before installing.

C. Start installation of roofing in presence of roofing system manufacturer's technical personnel and Owner's testing and inspection agency.

D. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

E. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.

F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.

G. Apply roof membrane with side laps shingled with slope of roof deck where possible.

H. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.

I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

3.9 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.10 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.

1. Install flexible walkways at the following locations:
   a. Perimeter of each rooftop unit.
   b. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
   c. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
   d. Top and bottom of each roof access ladder.
   e. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.
   f. Locations indicated on Drawings.
   g. As required by roof membrane manufacturer's warranty requirements.
2. Provide 6-inch clearance between adjoining pads.
3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, roof membrane application, sheet flashings, protection, and drainage components, and to furnish reports to Architect.

B. Owner will engage a qualified testing agency to perform the following tests:

1. Infrared Thermography: Testing agency shall survey entire roof area using infrared color thermography according to ASTM C 1153.

a. Perform tests before overlying construction is placed.
b. After infrared scan, locate specific areas of leaks by electrical capacitance/impedance testing or nuclear hydrogen detection tests.
c. After testing, repair leaks, repeat tests, and make further repairs until roofing and flashing installations are watertight.

1) Cost of retesting is Contractor's responsibility.

d. Testing agency shall prepare survey report of initial scan indicating locations of entrapped moisture, if any.

2. Testing agency shall prepare survey report indicating locations of initial discontinuities, if any.

C. Installer shall provide field quality control by certified staff and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

D. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

E. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

F. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.12 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect

roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.13 ROOFING INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: _____.
2. Address: _____.
3. Building Name/Type: _____.
4. Address: _____.
5. Area of Work: _____.
6. Acceptance Date: _____.
7. Warranty Period: _____.
8. Expiration 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 Roofing Installer will, at Roofing Installer's 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 _____;
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 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 THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 07 54 19

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed roof-drainage sheet metal fabrications.
2. Formed low-slope roof sheet metal fabrications.
3. Formed roof-drainage sheet metal fabrications.
4. Formed wall sheet metal fabrications.
5. Formed equipment support flashing.
6. Formed overhead-piping safety pans.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07 52 00 “Modified Bituminous Membrane Roofing" for installation of sheet metal flashing and trim integral with roofing.
3. Section 07 42 13.23 "Metal Composite Material Wall Panels" for sheet metal flashing and trim integral with metal wall panels.
4. Section 07 72 00 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review requirements for insurance and certificates if applicable.
4. Review sheet metal flashing observation and repair procedures after flashing installation.

B. Coordinate Preinstallation conference with other trades and conduct separate meetings as required and related to other trades.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Shop drawings

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Include details of roof-penetration flashing.
9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
10. Include details of special conditions.
11. Include details of connections to adjoining work.
12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

D. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

E. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches 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 long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.

C. Product Test Reports: For each product, for tests performed by a qualified testing agency.

D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: 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.

1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Refer to Section 01 43 39 “Visual Mock-Up Requirements” for additional requirements.

1.9 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 extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal coping systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, puncturing, or wind upload.
   b. Deterioration of metals and other materials beyond normal weathering.
2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

C. Special Weathertightness and Wind Speed Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace metal coping assemblies that fail to remain weathertight, including leaks, within specified warranty period. Warranty applies to damage caused by wind speeds of 150 MPH or less,

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies 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. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. FM Approvals Listing: Manufacture and install copings and roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with name of fabricator and design approved by FM Approvals.

D. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

E. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental

effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

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

B. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

C. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Exposed Coil-Coated Finish:
   a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 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.
2. Color: As selected by Architect from manufacturer's full range.
3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.
4. Recycled Content of Aluminum Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
   a. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Finish: 2D (dull, cold rolled).
2. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
   a. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.

2.3 UNDERLAYMENT MATERIALS

A. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt; nonperforated.

B. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

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. GCP Applied Technologies Inc. (formerly Grace Construction Products); Grace Ice and Water Shield HT.
   b. Henry Company; Blueskin PE200 HT.
   c. Polyguard Products, Inc.; Deck Guard HT.

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

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as 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. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
   b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

C. Solder:

1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

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

E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

G. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

H. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

I. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.5 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Through-Wall, Ribbed, Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry, with ribs at 3-inch intervals along length of flashing to provide integral mortar bond. Manufacture through-wall flashing with interlocking counterflashing on exterior face, of same metal as flashing.

1. Stainless Steel: 0.016 inch thick.

B. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with interlocking counterflashing on exterior face, of same metal as reglet.

1. Material: Stainless steel, 0.019 inch thick.
2. 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.
3. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
5. Accessories:
    a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
    b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
6. Finish: Mill.

C. Preformed Metal Flashing.

1. Basis of Design: SBC Flashings.
2. Material: 26 gauge stainless steel type 304, 2B finish, ASTM A240.
3. Size: As required.

2.6 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and SMACNA recommendations, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in 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 to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners 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 on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1-inch-deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

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 cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

H. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.

I. Do not use graphite pencils to mark metal surfaces.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing (Gravel Stop): Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long sections. Furnish with 6-inch-wide, joint cover plates.

1. Joint Style: Overlapped, 4 inches wide.
2. Fabricate from the Following Materials:
   a. Aluminum: 0.050 inch thick.

B. Copings: Fabricate in minimum 96-inch-long, but not exceeding 12-foot-long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and interior leg. Miter corners, solder or weld watertight.

1. Coping Profile: Fig 3-4A according to SMACNA's "Architectural Sheet Metal Manual."
2. Joint Style: Butted with expansion space and 6-inch-wide, concealed backup plate.
3. Fabricate from the Following Materials:
   a. Aluminum: 0.050 inch thick.

C. Roof-to-Wall Transition Expansion-Joint Cover: Fabricate from the following materials:

1. Stainless Steel: 0.025 inch thick.

D. Base Flashing: Fabricate from the following materials:

1. Aluminum: 0.040 inch thick.

E. Counterflashing: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

F. Flashing Receivers: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

G. Roof-Drain Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

2.8 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

C. Wall Expansion-Joint Cover: Fabricate from the following materials:

1. Aluminum: 0.040 inch thick.

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

B. Overhead-Piping Safety Pans: Fabricate from the following materials:

1. Stainless Steel: 0.025 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within manufacturer’s recommended exposure limit.

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, 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, levels, and slopes. 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 apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.
6. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or

by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum and stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1-inch-deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder aluminum sheet.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
4. Stainless-Steel Soldering: Tin edges of uncoated sheets, using solder for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated.

Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters: Join sections with riveted and soldered joints or joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Anchor and loosely lock back edge of gutter to continuous cleat.
2. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
3. Anchor gutter with straps spaced not more than 24 inches 30 inches apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
4. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.

C. Downspouts: Join sections with 1-1/2-inch 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 o.c.
2. Provide elbows at base of downspout to direct water away from building.

D. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated. Lap joints minimum of 4 inches in direction of water flow.

3.5 ROOF FLASHING INSTALLATION

A. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

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 over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of interlocking folded seam or blind rivets and sealant unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with butyl 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 cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, and similar flashings to extend 4 inches beyond wall openings.

3.7 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

B. Overhead-Piping Safety Pans: Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings. Pipe and install drain line to plumbing waste or drainage system.

3.8 ERECTION TOLERANCES

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

3.9 FIELD QUALITY CONTROL

A. Installer shall provide field quality control by staff having adequate prior experience and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provideweekly updates verifying all locations have been inspected and are free of installation defects and damage.
    a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
    b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

3.10 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 sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in 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.

3.11 FABRICATION SCHEDULE

A. Coated aluminum, 0.040-inch

1. Edge Metal
2. Parapet Caps
3. Cover Plates
4. Backer Plates
5. Fascia Metal

B. Stainless Steel, 22 Gauge.

1. Hook Strips
2. Cleats
3. Securement Clips

C. Stainless steel, 24 gauge

1. Expansion Joint covers
    a. Counterflashing
    b. Skirt Flashing
    c. Scupper
    d. Cone Flashing/Storm Hood
    e. Vent Pipe Sleeves and Caps
    f. Pourable Sealer Pocket
    g. J-Vent

D. Coated Aluminum, 0.062 inch.

1. Downspouts and Straps
2. Conductor Head

E. Mill Finish Aluminum, 0.093 inch.

1. Termination Bars
2. Gutter Hangers

END OF SECTION 07 62 00

SECTION 07 71 29 - MANUFACTURED ROOF EXPANSION JOINTS

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Flanged bellows-type roof expansion joints.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wooden curbs or cants for mounting roof expansion joints.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Expansion joint manufacturer representative shall attend the Preinstallation conference.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Shop Drawings: For roof expansion joints.

1. Include plans, elevations, sections, and attachment details.
2. Include details of splices, intersections, transitions, fittings, method of field assembly, and location and size of each field splice.
3. Provide isometric drawings of intersections, terminations, changes in joint direction or planes, and transition to other expansion joint systems depicting how components interconnect with each other and adjacent construction to allow movement and achieve waterproof continuity.

D. Samples: For each exposed product and for each color specified, 6 inches in size.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each fire-barrier provided as part of a roof-expansion-joint assembly, for tests performed by a qualified testing agency.

C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer of roofing membrane.

1.7 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace roof expansion joints and components that leak, deteriorate beyond normal weathering, or otherwise fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint seals, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 BELLOWS-TYPE ROOF EXPANSION JOINTS

A. Bellows-Type Roof Expansion Joint: Factory-fabricated, continuous, waterproof, joint cover consisting of exposed membrane bellows each edge. Parking Garage Only)

1. Basis-of-Design Product: Subject to compliance with requirements, provide Nystrom, Inc.; EWCF series or a comparable product by one of the following:
   a. Balco, Inc.
   b. MM Systems Corporation.
2. Joint Movement Capability: Plus and minus 50 percent of joint size.
3. Bellows: EPDM flexible membrane, nominal 60 mils thick.
4. Flanges: Stainless Steel
5. Configuration: as indicated on Drawings.
6. Corner, Intersection, and Transition Units: Provide factory-fabricated units for corner and joint intersections and horizontal and vertical transitions including those to other building expansion joints.
7. Cover Membrane: EPDM flexible membrane, factory laminated to bellows and covering entire joint assembly and curbs.
   a. Color: Black.
8. Accessories: Provide splicing units, adhesives, and other components as recommended by roof-expansion-joint manufacturer for complete installation.

B. Materials:

1. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
2. EPDM Membrane: ASTM D 4637/D 4637M, type standard with manufacturer for application.

2.3 COMPRESSION-TYPE ROOF EXPANSION JOINTS

A. Roof-to-Roof (REJ-A):

1. Basis-of-Design Product: Emseal Joint Systems, LTD., COLORSEAL
2. Preformed sealant shall be silicone pre-coated, preformed, pre-compressed, self-expanding, sealant system. Expanding foam to be cellular foam impregnated with a water-based, non-drying, 100% acrylic dispersion. Seal shall combine factory-applied, low-modulus silicone and a backing of acrylic-impregnated expanding foam into a unified hybrid sealant system.
3. Material shall be capable of movements of +25%, -25% (50% total) of nominal material size
4. Silicone external color facing to be factory-applied to the foam while it is partially pre-compressed to a width greater than maximum joint extension and cured before final compression. When compressed to final supplied dimension, a bellow(s) to handle movement must be created in the silicone coating.
   a. Color: As selected by Architect from manufacturer's full range.

2.4 TORCHABLE EXPANSION JOINTS

A. Roof-to-Wall (REJ-B)

1. Basis-of-Design Product: SITURA Inc.; FlamLINE 40.
2. Flat, vulcanized waterproof joint integral with roofing membrane to accommodate movements up to +4-inches, -4-inches (500% at -40 degrees F.).

~~2.4~~2.5 MISCELLANEOUS MATERIALS

A. Adhesives: As recommended by roof-expansion-joint manufacturer.

B. Fasteners: Manufacturer's recommended stainless steel fasteners, suitable for application and designed to withstand design loads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joint openings, substrates, and expansion-control joint systems that interface with roof expansion joints, for suitable conditions where roof expansion joints will be installed.

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

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for handling and installing roof expansion joints.

1. Anchor roof expansion joints securely in place, with provisions for required movement. Use fasteners, protective coatings, sealants, and miscellaneous items as required to complete roof expansion joints.

2. Install roof expansion joints true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
3. Provide for linear thermal expansion of roof expansion joint materials.
4. Provide uniform profile of roof expansion joint throughout its length; do not stretch or squeeze membranes.
5. Provide uniform, neat seams.
6. Install roof expansion joints to fit substrates and to result in watertight performance.

B. Directional Changes: Install factory-fabricated units at directional changes to provide continuous, uninterrupted, and watertight joints.

C. Transitions to Other Expansion-Control Joint Assemblies: Coordinate installation of roof expansion joints with other exterior expansion-control joint assemblies specified in Section 07 95 13.16 "Exterior Expansion Joint Cover Assemblies" to result in watertight performance.

D. Splices: Splice roof expansion joints to provide continuous, uninterrupted, and waterproof joints.

1. Install waterproof splices and prefabricated end dams to prevent leakage of secondary-seal membrane.

3.3 FIELD QUALITY CONTROL

A. Installer shall provide field quality control by certified staff and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
   a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
   b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

END OF SECTION 07 71 29

SECTION 07 72 00 - ROOF 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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Roof curbs (not specified elsewhere).
2. Equipment supports.
3. Roof hatches.
4. Pipe and duct supports.
5. Pipe portals.
6. Preformed flashing sleeves.

B. Related Sections:

1. Section 05 50 00 "Metal Fabrications" for metal vertical ladders, ships' ladders, and stairs for access to roof hatches.
2. Section 05 52 13 "Pipe and Tube Railings" for safety railing systems not attached to roof-hatch curbs.
3. Section 07 62 00 "Sheet Metal Flashing and Trim" for shop- and field-formed metal flashing, roof-drainage systems, roof expansion-joint covers, and miscellaneous sheet metal trim and accessories.
4. Section 23 05 48 "Vibration Controls for HVAC" for special curbs designed to accommodate seismic and vibration controls.
5. Section 23 34 23 "HVAC Power Ventilators" for power roof-mounted ventilators.

1.3 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of roof accessory.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Leadership Extraction Practices in the following:
   a. Leadership Extraction Practices for Recycled Content
2. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Paints and Coatings

C. Shop Drawings: For roof accessories.

1. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

D. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

E. Delegated-Design Submittal: For roof curbs and equipment supports indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail mounting, securing, and flashing of roof-mounted items to roof structure. Indicate coordinating requirements with roof membrane system.
2. Wind-Restraint Details: Detail fabrication and attachment of wind restraints. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof plans, drawn to scale, and coordinating penetrations and roof-mounted items. Show the following:

1. Size and location of roof accessories specified in this Section.
2. Method of attaching roof accessories to roof or building structure.
3. Other roof-mounted items including mechanical and electrical equipment, ductwork, piping, and conduit.
4. Required clearances.

B. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals.

1.8 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 45 00 “Quality Control”, to design roof curbs and equipment supports to comply with wind performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind-Restraint Performance: As indicated on Drawings.

D. Sustainability Requirements

1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.
   a. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional information and requirements for recycled content.
2. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:
   a. Product specific declarations in accordance with ISO 1404
   b. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
   c. Industry Wide Product Specific Type III EPD Third Party Certification

2.2 ROOF CURBS

A. Roof Curbs: Internally reinforced roof-curb units capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings, bearing continuously on roof structure, and capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, straight sides, and integrally formed deck-mounting flange at perimeter bottom.

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Stainless-steel sheet, 0.078 inch thick.

1. Finish: No. 2D, directional polish finish.

D. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
3. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.
4. Top Surface: Level top of curb, with roof slope accommodated by sloping deck-mounting flange.
5. Insulation: Factory insulated with 1-1/2-inch-thick glass-fiber board insulation.
6. Liner: Same material as curb, of manufacturer's standard thickness and finish.
7. Nailer: Factory-installed wood nailer along top flange of curb, continuous around curb perimeter.
8. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb, of size and spacing required to meet wind uplift requirements.
9. Platform Cap: Where portion of roof curb is not covered by equipment, provide weathertight platform cap formed from 3/4-inch thick plywood covered with metal sheet of same type, thickness, and finish as required for curb.
10. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as curb.

2.3 EQUIPMENT SUPPORTS

A. Equipment Supports: Rail-type metal equipment supports capable of supporting superimposed live and dead loads between structural supports, including equipment loads and other construction indicated on Drawings, spanning between structural supports; capable of meeting performance requirements; with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed structure-mounting flange at bottom.

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. Air Balance; a division of MESTEK, Inc.
   b. Curbs Plus, Inc.
   c. Greenheck Fan Corporation.
   d. Pate Company (The).

B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.

C. Material: Zinc-coated (galvanized) steel sheet, 18 ga. thick.

D. Construction:

1. Curb Profile: Manufacturer's standard compatible with roofing system.
2. Nailer: Factory-installed continuous wood nailers 3-1/2 inches wide under top flange on side of curb, continuous around support perimeter.
3. Wind Restraint Straps and Base Flange Attachment: Provide wind restraint straps, welded strap connectors, and base flange attachment to roof structure at perimeter of curb of size and spacing required to meet wind uplift requirements.
4. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
5. On ribbed or fluted metal roofs, form deck-mounting flange at perimeter bottom to conform to roof profile.
6. Fabricate equipment supports to minimum height of 12 inches above roofing surface unless otherwise indicated.

2.4 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated single-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Babcock-Davis.
   b. Bilco Company (The).
   c. Dur-Red Products.
   d. JL Industries, Inc.; a division of the Activar Construction Products Group.
   e. Lexcor; a division of Luxsuco corp.
   f. Milcor; Commercial Products Group of Hart & Cooley, Inc.
   g. O'Keeffe's Inc.
   h. Precision Ladders, LLC.

B. Type and Size: Single-leaf lid, 30 by 54 inches unless noted otherwise.

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material: Zinc-coated (galvanized) steel sheet.

1. Thickness: Manufacturer's standard thickness for hatch size indicated.
2. Finish: Baked enamel or powder coat.
3. Color: As selected by Architect from manufacturer's full range.

E. Construction:

1. Insulation: Polyisocyanurate board.
2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.

5. Fabricate curbs to minimum height of 12 inches above roofing surface unless otherwise indicated.

F. Hardware: Spring operators, hold-open arm, stainless-steel spring latch with turn handles, stainless-steel butt- or pintle-type hinge system, and padlock hasps inside and outside.

G. Door Position Switches: Sentrol 2707AD High Security Concealed Magnetic Contacts.

1. Provide surface mount switches on secure side of hatch.

H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches above finished roof deck.
3. Material: Steel tube.
4. Post: 1-5/8-inch-diameter pipe.
5. Finish: Manufacturer's standard baked enamel or powder coat.
   a. Color: As selected by Architect from manufacturer's full range.

I. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

1. Height: 42 inches (1060 mm) above finished roof deck.
2. Posts and Rails: Galvanized-steel pipe, 1-1/4 inches (31 mm) in diameter or galvanized-steel tube, 1-5/8 inches (41 mm) in diameter.
3. Flat Bar: Galvanized steel, 2 inches (50 mm) high by 3/8 inch (9 mm) thick.
4. Maximum Opening Size: System constructed to prevent passage of a sphere 21 inches (533 mm) in diameter.
5. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
6. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.
7. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.
8. Fabricate joints exposed to weather to be watertight.
9. Fasteners: Manufacturer's standard, finished to match railing system.
10. Finish: Manufacturer's standard.
    a. Color: As selected by Architect from manufacturer's full range.

2.5 PIPE AND DUCT SUPPORTS

A. Curb-Mounted Pipe Supports: Galvanized steel support with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom; with adjustable-height roller-bearing pipe support accommodating up to 20-inch-

diameter pipe or conduit and with provision for pipe retainer; as required for quantity of pipe runs and sizes.

B. Duct Supports: Extruded-aluminum, urethane-insulated supports, 2 inches in diameter; with manufacturer's recommended hardware for mounting to structure or structural roof deck.

2.6 PIPE PORTALS

A. Curb-Mounted Pipe Portal: Insulated roof-curb units with welded or mechanically fastened and sealed corner joints, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom; with weathertight curb cover with single or multiple collared openings and pressure-sealed conically shaped EPDM protective rubber caps sized for piping indicated, with stainless-steel snaplock swivel clamps.

2.7 PREFORMED FLASHING SLEEVES

A. Exhaust Vent Flashing: Double-walled stainless-steel flashing sleeve or boot, insulation filled, with integral deck flange, 12 inches high, with removable metal hood and metal collar.

B. Vent Stack Flashing: Stainless steel flashing sleeve, uninsulated, with integral deck flange.

C. Flexible Pipe Boot: Pleated EPDM cone with corrosion resistant aluminum base and adjustable collar. Available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Firestone Building Products.
2. Carlisle SynTec.
3. Johns Manville.

2.8 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

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

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.

1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

C. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

D. Roof-Hatch Installation:

1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
2. Attach safety railing system to roof-hatch curb.
3. Attach ladder-assist post according to manufacturer's written instructions.

E. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.

1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

F. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

G. Seal joints with sealant as required by roof accessory manufacturer.

3.3 FIELD QUALITY CONTROL

A. Installer shall provide field quality control by staff having adequate prior experience and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.
    a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
    b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.
2. Provide field inspection reports within 5 working days of inspection.

3.4 REPAIR AND CLEANING

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

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Section 09 91 13 "Exterior Painting."

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

SECTION 07 81 00 - APPLIED FIREPROOFING

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section includes sprayed fire-resistive materials.

B. Related Requirements:

1. Section 07 81 23 "Intumescent Fireproofing" for mastic and intumescent fire-resistive coatings.

1.3 DEFINITIONS

A. SFRM: Sprayed fire-resistive materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Paints and Coatings
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Corporate Sustainability Reporting (CSR’s)
   c. Health Product Declarations (HPD’s)

C. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of fireproofing after application.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Product Certificates: For each type of fireproofing.

C. Evaluation Reports: For fireproofing, from ICC-ES.

D. Preconstruction Test Reports: For fireproofing.

E. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fireproofing from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. Sustainability Requirements

1. Low Emitting Paints & Coatings
   a. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.

b. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.

2. Health Product Declaration: Provide Health Product Declaration (HPD) with full disclosure of known hazards in compliance with the Health Product Declaration Open Standard
3. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:
   a. Product specific declarations in accordance with ISO 1404
   b. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
   c. Industry Wide Product Specific Type III EPD Third Party Certification

E. Asbestos: Provide products containing no detectable asbestos.

2.2 STANDARD DURABILITY SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application. Dry mix inorganic materials consisting of mineral slag wool and Portland cement are not permitted.

1. Provide in areas where high durability spray fire-resistive material is not required.

B. Basis if Design Product: Subject to compliance with requirements, provide GCP Applied Technologies; Monokote MK-10/HB or comparable product by one of the following manufacturers.

1. Carboline
2. Isolatek International

C. Bond Strength: Minimum 600-lbf/sq. ft. cohesive and adhesive strength based on field testing according to ASTM E 736.

D. Density: Not less than density specified in the approved fire-resistance design, according to ASTM E 605.

E. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch.

F. Combustion Characteristics: ASTM E 1354.

G. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 10 or less.
2. Smoke-Developed Index: 10 or less.

H. Compressive Strength: Minimum 31 lbf/sq. in. according to ASTM E 761.

I. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.

J. Deflection: No cracking, spalling, or delamination according to ASTM E 759.

K. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.

L. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours according to ASTM E 859.

M. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21 or rating of 10 according to ASTM D 3274 when tested according to ASTM D 3273.

2.3 HIGH DURABILITY SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application. Dry mix inorganic materials consisting of mineral slag wool and Portland cement are not permitted.

1. Provide on columns in mechanical room, electrical rooms, MDF rooms, IDF rooms, and other locations where application will be exposed.

B. Basis if Design Product: Subject to compliance with requirements, provide GCP Applied Technologies; Monokote Z-146 or comparable product by one of the following manufacturers.

1. Carboline
2. Isolatek International

C. Bond Strength: Minimum 10,000-lbf/sq. ft. cohesive and adhesive strength based on field testing according to ASTM E 736.

D. Density: Not less than density specified in the approved fire-resistance design, according to ASTM E 605.

E. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch.

F. Combustion Characteristics: ASTM E 1354.

G. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 10 or less.
2. Smoke-Developed Index: 10 or less.

H. Compressive Strength: Minimum 500 lbf/sq. in. according to ASTM E 761.

I. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.

J. Deflection: No cracking, spalling, or delamination according to ASTM E 759.

K. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.

L. Air Erosion: Maximum weight loss of 0.000 g/sq. ft. in 24 hours according to ASTM E 859.

M. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21 or rating of 10 according to ASTM D 3274 when tested according to ASTM D 3273.

2.4 MEDIUM DURABILITY SPRAYED FIRE-RESISTIVE MATERIALS

A. Sprayed Fire-Resistive Material: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application. Dry mix inorganic materials consisting of mineral slag wool and Portland cement are not permitted.

1. Provide on beams and other members located ten feet or more above finish floor in mechanical rooms, electrical rooms, MDF rooms, IDF rooms, and other locations where application will be exposed.

B. Basis if Design Product: Subject to compliance with requirements, provide GCP Applied Technologies; Monokote Z-106/HY or comparable product by one of the following manufacturers.

1. Carboline
2. Isolatek International

C. Bond Strength: Minimum 2,000-lbf/sq. ft. cohesive and adhesive strength based on field testing according to ASTM E 736.

D. Density: Not less than density specified in the approved fire-resistance design, according to ASTM E 605.

E. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch.

F. Combustion Characteristics: ASTM E 1354.

G. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 10 or less.
2. Smoke-Developed Index: 10 or less.

H. Compressive Strength: Minimum 100 lbf/sq. in. according to ASTM E 761.

I. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.

J. Deflection: No cracking, spalling, or delamination according to ASTM E 759.

K. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.

L. Air Erosion: Maximum weight loss of 0.000 g/sq. ft. in 24 hours according to ASTM E 859.

M. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21 or rating of 10 according to ASTM D 3274 when tested according to ASTM D 3273.

~~2.4~~2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:

1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.

C. Bonding Agent: Product approved by fireproofing manufacturer and complying with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Verify that concrete work on steel deck is complete before beginning fireproofing work.

C. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete in the Work area before beginning fireproofing work.

D. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

C. Shop prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

1. Refer to Division 05 Sections.

D. For applications, visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.

1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

E. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

F. Extend fireproofing in full thickness over entire area of each substrate to be protected.

G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

I. Cure fireproofing according to fireproofing manufacturer's written instructions.

J. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by Chapter 17 of the applicable building code.
2. Shop drawings showing the minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly must be obtained from the architect.

B. Perform the tests and inspections of completed Work in Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

C. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 07 81 00

SECTION 07 81 23 - INTUMESCENT FIREPROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes mastic and intumescent fire-resistive coatings.

B. Related Requirements:

1. Section 07 81 00 "Applied Fireproofing" for sprayed fire-resistive materials (SFRM).

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review products, design ratings, restrained and unrestrained conditions, thicknesses, and other performance requirements.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Paints and Coatings
   b. Low Emitting Materials for Adhesives and Sealants
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Health Product Declarations (HPD’s)

C. Shop Drawings: Framing plans or schedules, or both, indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of fireproofing after application.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Product Certificates: For each type of fireproofing.

C. Evaluation Reports: For fireproofing, from ICC-ES.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 50 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fireproofing from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. Low Emitting Paints & Coatings

1. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
2. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.

E. Asbestos: Provide products containing no detectable asbestos.

2.2 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

A. Mastic and Intumescent Fire-Resistive Coating for Conditioned Interior Space Application: Manufacturer's standard, factory-mixed formulation or factory-mixed, multicomponent system consisting of intumescent base coat and topcoat, and complying with indicated fire-resistance design.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Carboline Company; a subsidiary of RPM International; Thermosorb VOC ~~AD Firefilm III~~ or comparable product by one of the following manufacturers.
   a. International Paint, LLC
   b. Isolatek International
2. Application: Designated for "conditioned interior space purpose" use by a qualified testing agency acceptable to authorities having jurisdiction.

B. Mastic and Intumescent Fire-Resistive Coating for Exterior Application: Manufacturer's standard, factory-mixed formulation or factory-mixed, multicomponent system consisting of intumescent base coat and topcoat, and complying with indicated fire-resistance design.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Carboline Company; a subsidiary of RPM International; Thermosorb VOC ~~Thermo-Lag E100~~ or comparable product by one of the following manufacturers.
   a. International Paint, LLC
   b. Isolatek International
2. Application: Designated for “exterior” use by a qualified testing agency acceptable to authorities having jurisdiction.

C. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.

D. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

E. Hardness: Not less than 65, Type D durometer, according to ASTM D 2240.

F. Finish: Smooth

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.

B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

C. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.

D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.

E. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

1. Provide fireproofing manufacturer approved topcoat to match Architect's sample.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design.

1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
2. Verify that objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
3. Verify that substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.

B. Conduct tests according to fireproofing manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

C. 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. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.

B. Clean substrates of substances that could impair bond of fireproofing.

C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.

D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for

thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.

1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

E. Spray apply fireproofing to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

F. Extend fireproofing in full thickness over entire area of each substrate to be protected.

G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

I. Cure fireproofing according to fireproofing manufacturer's written instructions.

J. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

K. Finishes: Where indicated, apply fireproofing to produce the following finishes:

1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Test and inspect as required by the FBC, Subsection 17 05 .14, "Mastic and Intumescent Fire-Resistant Coatings."

B. Perform the tests and inspections of completed Work in successive stages. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.

1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing is without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 07 81 23

SECTION 07 84 13 - PENETRATION FIRESTOPPING

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.
3. Penetrations in smoke barriers.

B. Related Requirements:

1. Section 07 84 43 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Paints and Coatings
   b. Low Emitting Materials for Adhesives and Sealants
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

~~A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."~~

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
   a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
      1) UL in its "Fire Resistance Directory."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Low Emitting Materials

1. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
2. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.

B. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

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. Carboline Company.
   b. GCP Applied Technologies.
   c. Pecora Corporation.

C. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

D. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

E. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg.

1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at and no more than 50-cfm cumulative total for any 100 sq. ft. at both ambient and elevated temperatures.

F. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials, including the following:
   a. Slag-wool-fiber or rock-wool-fiber insulation.
   b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
   c. Fire-rated form board.
   d. Fillers for sealants.
2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Low Emitting Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

1. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
2. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Provide approved manufacturers' systems for type of opening, construction penetrated and penetrating material. Assemblies will include, but are not limited to, the following conditions:

1. With No Penetrating Items.
2. Structural Items.
3. Metallic Pipes, Conduit, or Tubing.
4. Nonmetallic Pipe, Conduit, or Tubing.
5. Electrical Cables.
6. Cable Trays with Electric and Data Cables.
7. Insulated Pipes.
8. Miscellaneous Plumbing Penetrants.
9. Miscellaneous Mechanical Penetrants
10. Miscellaneous Electrical Penetrants.
11. Groupings of Penetrants.

C. Type of Fill Materials: As required to achieve ratings.

END OF SECTION 07 84 13

SECTION 07 84 43 - JOINT FIRESTOPPING

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Joints in or between fire-resistance-rated constructions.
2. Joints at exterior curtain-wall/floor intersections.
3. Joints in smoke barriers.

B. Related Requirements:

1. Section 07 84 13 "Penetration Firestopping" for penetrations in fire-resistance-rated walls, horizontal assemblies, and smoke barriers and for wall identification.
2. Section 07 95 13.13 “Interior Expansion Joint Cover Assemblies" and 07 95 13.16 “Exterior Expansion Joint Cover Assemblies” for fire-resistive architectural joint systems.
3. Section 07 95 01 "Expansion Control – Parking Garage" for fire-resistive manufactured expansion-joint cover assemblies subject to vehicular traffic.
4. Section 09 22 16 "Non-Structural Metal Framing" for firestop tracks for metal-framed partition heads.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Adhesives and Sealants
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)

C. Product Schedule: For each joint firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing agency's illustration for a particular joint firestopping system condition, submit illustration, with modifications marked, approved by joint

firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each joint firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that joint firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

~~A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."~~

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install joint firestopping systems when ambient or substrate temperatures are outside limits permitted by joint firestopping system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure joint firestopping systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of joints to ensure that joint firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of joints to accommodate joint firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform joint firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Joint Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    a. Joint firestopping systems shall bear classification marking of a qualified testing agency.
        1) UL in its "Fire Resistance Directory."

2.2 JOINT FIRESTOPPING SYSTEMS

A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Low Emitting Adhesives and Sealants

1. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
2. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.

C. Health Product Declaration: Provide Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration Open Standard

D. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

E. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.

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. Hilti, Inc.; FS-One Max Firestop Sealant.
    b. Specified Technologies, Inc.: SIL Silicone Firestop Sealant.
    c. Tremco, Inc.; TREMstop IA+.
2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

F. Joints at Exterior Curtain-Wall/Floor Intersections: Provide joint firestopping systems with rating determined per ASTM E 2307.

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. Hilti, Inc.; Firestop Joint Spray CFS-SP.
    b. Specified Technologies, Inc.: AS200 Elastomeric Spray.

c. Tremco, Inc.; TREMstop Acrylic SP.

2. F-Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.

G. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079 based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).

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. Hilti, Inc.; FS-One Max Firestop Sealant.
   b. Tremco, Inc.; TREMstop Smoke & Sound Sealant.
   c. USG Sheetrock Brand Firecode; Smoke-Sound Sealant.
2. L-Rating: Not exceeding 5.0 cfm/ft. (0.00775 cu. m/s x m) of joint at both ambient and elevated temperatures.

H. Pre-Cut Flute Fire-Rated Insulation: Pre-formed mineral wool designed to fit flutes of metal profile deck and gap between top of wall and metal deck profile; use as a backer for spray material.

I. Mineral Wool Fire-Safing Insulation: Unfaced, inorganic, noncombustible, moisture resistant mineral wool insulation.

J. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

K. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning: Before installing fire-resistive joint systems, clean joints immediately to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of elastomeric fill materials or compromise fire-resistive rating.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with elastomeric fill materials. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by joint firestopping system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2393.

B. Where deficiencies are found or joint firestopping systems are damaged or removed due to testing, repair or replace joint firestopping systems so they comply with requirements.

C. Proceed with enclosing joint firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess elastomeric fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by joint firestopping system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure joint firestopping systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

C. Refer to Section 01 74 23 “Final Cleaning” for additional cleaning requirements.

3.7 JOINT FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHBN or Category XHDG.

1. Refer to Drawings for Basis-of-Design fire-resistive joint system assemblies.

END OF SECTION 07 84 43

SECTION 07 92 00 - JOINT SEALANTS

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silyl-terminated polyether joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

B. Related Requirements:

1. Section 32 13 73 "Concrete Paving Joint Sealants" for sealing joints in paved roads, parking lots, walkways, and curbing.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Sealant manufacturer technical representative shall be present at the Preinstallation conference.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Adhesives and Sealants
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Health Product Declarations (HPD’s)

C. 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.

D. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long

strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Field-Adhesion-Test Reports: For each sealant application tested.

D. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section. Refer to Section 01 43 39 “Visual Mock-Up Requirements” for additional requirements.

1.7 FIELD 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.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.8 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period:
   a. Exterior silicone vertical non-traffic sealant: five years from date of Substantial Completion.
   b. All other sealants: Five years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from 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 JOINT SEALANTS, 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 joint-sealant manufacturer, based on testing and field experience.

B. Health Product Declaration: Provide Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration Open Standard

C. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:

1. Product specific declarations in accordance with ISO 1404
2. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
3. Industry Wide Product Specific Type III EPD Third Party Certification

D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

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. Dow Corning Corporation.
   b. GE Construction Sealants; Momentive Performance Materials Inc.
   c. Pecora Corporation.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

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. BASF Corporation; Construction Systems.
   b. Pecora Corporation.

B. Urethane, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade P, Class 25, Uses T and NT.

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. BASF Corporation; Construction Systems.
   b. Pecora Corporation.

C. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Uses T and NT.

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. Tremco Incorporated.

2.4 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

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. Dow Corning Corporation.
   b. GE Construction Sealants; Momentive Performance Materials Inc.
   c. Pecora Corporation.

2.5 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

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. Bostik, Inc.
b. Pecora Corporation.

2.6 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Pecora Corporation.
b. The Sherwin Williams Company.
c. Tremco Incorporated.

2.7 IMMERSIBLE JOINT SEALANTS

A. Urethane, Immersible, S, NS, 35, T, NT, I: Immersible, single-component, nonsag, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 35, Uses T, NT, and I.

1. Products: Subject to compliance with requirements, provide one of the following:
a. BASF Corp. - Construction Chemicals; MasterSeal NP 1 (Pre-2014: Sonolastic NP1).
b. Sika Corporation; Joint Sealants; Sikaflex 1a.

2.8 EXTRUDED-SILICONE JOINT SEALS

A. Extruded-Silicone Joint Seals: Manufacturer's standard seal consisting of precured low-modulus silicone extrusion, with a neutral-curing silicone sealant for bonding extrusions to substrates.

1. Products: Subject to compliance with requirements, provide the following:
a. The Dow Chemical Company; Dow Corning® 123 Silicone Seal.
2. Joint Seal Color: As selected by Architect from full range of industry colors.

~~2.8~~2.9 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and 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) 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. 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. Provide self-adhesive tape where applicable.

~~2.9~~2.10 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 performance of the Work.

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, 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.
    a. Refer to Section 01 35 46 “Indoor Air Quality” and Section 01 74 23 “Final Cleaning” for requirements.
4. Clean nonporous joint substrate 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 by joint-sealant manufacturer or as indicated by 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 or primer 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. Install sealant backings of kind 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.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. 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.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs 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. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
3. Use tooling agents are not allowed.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Manufacturer shall field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints on each building elevation as follows:
   a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
   b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. 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 kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
4. 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 material, sealant configuration, and sealant dimensions.
5. 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-Adhesion-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.

C. Installer shall provide field quality control by staff having adequate prior experience and shall provide the following reports and checklists.

1. BECxA shall provide initial BECx checklists. Contractor shall provide weekly updates verifying all locations have been inspected and are free of installation defects and damage.

a. BECx Checklists shall include specific locations of the work and specific location and description of any repairs.
b. BECx checklist shall be completed in its entirety and shall be provided weekly to the Construction Manager, Architect, and Owner.

2. Provide field inspection reports within 5 working days of inspection.

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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.

1. Joint Locations:
   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. Other joints as indicated on Drawings.
2. Joint Sealant: Urethane, M, P, 50, T, NT.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
   a. Construction joints in cast-in-place concrete.
   b. Control and expansion joints in unit masonry.
   c. Joints between metal panels.
   d. Joints between different materials listed above.
   e. Perimeter joints between materials listed above and frames of doors.
   f. Control and expansion joints in ceilings and other overhead surfaces.
   g. Other joints as indicated on Drawings.
2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:
   a. Isolation joints in cast-in-place concrete slabs.
   b. Control and expansion joints in tile flooring.
   c. Other joints as indicated on Drawings.
2. Joint Sealant: Urethane, S, P, 25, T, NT.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Tile control and expansion joints.
   c. Vertical joints on exposed surfaces of unit masonry.
   d. Other joints as indicated on Drawings.
2. Joint Sealant: Urethane, S, NS, 25, NT.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:
   a. Control joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints between interior wall surfaces and frames of interior doors and elevator entrances.
   c. Other joints as indicated on Drawings.
2. Joint Sealant: Acrylic latex.

F. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. Other joints as indicated on Drawings.
2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.

G. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:
   a. Aluminum thresholds.
   b. Sill plates.
   c. Other joints as indicated on Drawings.
2. Joint Sealant: Butyl-rubber based.
3. Joint-Sealant Color: As indicated by manufacturer's designations.

END OF SECTION 07 92 00

SECTION 07 9201 - JOINT SEALANTS - PARKING GARAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:

1. Division 07 Section, “Traffic Coatings (Parking Garage)”
2. Division 07 Section, “Water Repellents (Parking Garage)”
3. Division 07 Section, “Joint Sealants (Parking Garage)”
4. Division 07 Section, “Expansion Control (Parking Garage)”

B. This Section includes the following:

1. Exterior joints in the following horizontal traffic bearing surfaces:
    a. Construction joints in cast-in-place concrete.
    b. Control joints in slab-on-grade, pour strips, slabs and topping slabs.
    c. Perimeter of all floor drains.
2. Exterior joints in the following vertical and horizontal non-traffic surfaces:
    a. Construction joints in cast-in-place concrete.
    b. Cove joints at intersection of horizontal and vertical concrete.
3. Interior joints refer to specification 07 9200.

C. Related Sections: Following Sections contain requirements that relate to this Section.

1. Division 01 Section "Shop Drawings, Product Data, and Samples~~Submittal Procedures~~."
2. Division 03 Section, "Cast-in-Place Concrete (Parking Garage)."
3. Division 03 Section “Post-Tensioned Concrete (Parking Garage).”
4. Division 07 Section 07 9200 “Joint Sealants” for requirements for interior enclosed spaces.
5. Division 07 Section "Expansion Control (Parking Garage)."
6. Division 07 Section "Water Repellents (Parking Garage)."
7. Division 07 Section "Traffic Coatings (Parking Garage)."
8. Division 07 Section, "Firestopping."
9. Division 09 Section "Pavement Marking."

1.3 UNIT PRICES

A. In Bid Form state:

1. Unit cost to rout, clean, prime and seal all cracks as noted by Engineer/Architect, prior to substantial completion. Base unit cost on quantity of 500 lineal ft.
2. Unit cost to rout, clean, prime and seal all cracks as noted by Engineer/Architect, during 1-yr warranty period. Base unit cost on quantity of 500 lineal ft.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
2. Distribute reviewed submittals to all others whose Work is related.
3. Coordinate layout of joint system and approve methods for providing joints with concrete contractors.
4. Inspect site before concrete placement to insure proper joint configuration.

B. Make submittals in accordance with requirements of Division 01 Section, “Submittal Procedures:”

1. See requirements of Division 01 Section, “Shop Drawings, Product Data, and Samples~~Submittal Procedures~~,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.
2. See requirements of Division 01 Section, “Shop Drawings, Product Data, and Samples~~Submittal Procedures~~,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.5 ACTION SUBMITTALS

A. Product Data: For each system indicated at least 60 days prior to application.

1. Product description, technical data, appropriate applications and limitations.
2. Primer type and application rate

B. Samples:

1. One for each system indicated.

C. Sample Warranty: For each system indicated.

D. Product Certificates: Refer to section 01 8113.14 “Sustainable Design Requirements – LEED V4 BD+C” for the following: Required for all areas.

a. Environmental Product Declarations (EPD’s)

b. Health Product Declarations (HPD’s)

c. Raw Material Source and Extraction Reporting

1.6 INFORMATION SUBMITTALS

A. Certificates:

1. Evidence of installer's being certified by manufacturer. Evidence shall include complete copy of manufacturer’s licensing/certification document, spelling out repair responsibility for warranty claims.
2. Certification from the Manufacturer that joint details as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive joint sealant.

B. Field Quality Control:

1. Two copies each of manufacturer's technical representative's log for each visit.
2. Testing agency field and test reports.

C. Qualification Statements:

1. Manufacturer’s qualifications as defined in the “Quality Assurance” article.
2. Installer’s qualifications as defined in the “Quality Assurance” article.
3. Signed statement from this Section applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.7 CLOSEOUT SUBMITTALS

A. Three copies of System Maintenance Manual.

B. Final executed Warranty.

1.8 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted system, to include:

a. Name and location of project.

b. Type of system applied.

c. On-Site contact with phone number.

B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.

C. Installer’s Qualifications: Owner retains right to reject any installer or subcontractor.

1. Installer shall be legally licensed to perform work in the state of Florida. Evidence of compliance with Summary article paragraph "A single installer. . ."
2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
3. Listing of 5 or more installations in climate and size similar to this Project performed by installer’s superintendent.

D. Testing Agency: Independent testing laboratory employed by Contractor and acceptable to Engineer/Architect.

E. Certifications:

1. Licensing/certification document from system manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer
2. Licensing/certification agreement shall include following information:

a. Applicator’s financial responsibility for warranty burden under agreement terms.

b. Manufacturer’s financial responsibility for warranty burden under agreement terms.

c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.

d. Authorized signatures for both Applicator Company and Manufacturer.

e. Commencement date of agreement and expiration date (if applicable).

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. Do not store material on slabs to be post-tensioned before final post-tensioning of slabs is accomplished. At no time shall weight of stored material being placed on slab area, after post-tensioning is completed and concrete has reached specified 28 day strength, exceed total design load of slab area. Between time final post-tensioning is accomplished and time concrete has reached specified 28 day strength, weight of stored material placed on slab area shall not exceed half total design load of slab area.

1.10 FIELD CONDITIONS

A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.11 WARRANTY

A. System Manufacturer and Contractor shall furnish Owner written single source performance guarantee that the joint sealant system will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any adhesive or cohesive failures.
2. Weathering.
3. Abrasion or tear failure resulting from normal traffic use.

B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.

C. Warranty period shall be a 5 year period commencing with date of acceptance of work.

D. Perform any repair under this warranty at no cost to Owner.

E. Address the following in the terms of the Warranty: length of warranty, change in value of warranty – if any- based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.

F. Vandalism and abnormally abrasive maintenance equipment are not normal traffic use and are exempted from warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:

1. BASF Building Systems (BASF), Shakopee, MN.
2. Dow Corning Corp. (Dow Corning), Midland, MI.
3. Lymtal International Inc. (Lymtal), Lake Orion, MI.
4. Pecora Corporation (Pecora), Harleysville, PA.
5. Sika Corporation (Sika), North Canton, OH.
6. Sonneborn, a Division of BASF Construction Chemicals (BASF).
7. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, JOINT SEALANT SYSTEM

A. Provide complete system of compatible materials designed by manufacturer to produce waterproof, traffic-bearing control joints as detailed on Drawings.

B. Compounds used for sealants shall not stain masonry or concrete. Aluminum pigmented compounds not acceptable.

C. Color of sealants shall match adjacent surfaces.

D. Closed cell or reticulated backer rods: Acceptable products:

1. “Sof Rod,” Nomaco Inc., 501 NMC Drive, Zebulon, NC 27597. (800) 345-7279 ext. 341.
2. “ITP Soft Type Backer Rod,” Industrial Thermo Polymers Limited, 2316 Delaware Ave., Suite 216, Buffalo, NY 14216. (800) 387-3847.
3. “Sonneborn Soft Type Backer Rod,” Sonneborn, Minneapolis, MN.

E. Bond breakers and fillers: as recommended by system manufacturer.

F. Primers: as recommended by sealant manufacturer.

G. Acceptable sealants are listed below. Sealants shall be compatible with all other materials in this Section and related work.

H. Acceptable polyurethane control joint sealants (traffic bearing):

1. Sonolastic SL-2, BASF.
2. Iso-flex 880 GB, Lymtal.
3. Dynatrol II-SG or Urexpan NR 200, Pecora.
4. Sikaflex-2c SL, Sika.
5. THC-900/901, Vulkem 45SSL, or Vulkem 245, Tremco.

I. Acceptable silicone control joint sealants (traffic bearing):

1. Spectrem 800/900SL, Tremco.
2. 310-SL, Pecora.
3. Dow Corning SL or FC Parking Structure Sealant, Dow Corning.

J. Acceptable polyurethane vertical and cove joints sealants (non-traffic bearing):

1. Sikaflex-2c NS, Sika.
2. Dymeric 240/240FC or THC 901 (cove only), Tremco.
3. Dynatred, Pecora.

4. Iso-flex 881, Lymtal.

K. Acceptable silicone vertical and cove joint sealants (non-traffic bearing):

1. Spectrem 1, Tremco.
2. 311-NS, Pecora.
3. Dow Corning NS Parking Structure Sealant, Dow Corning.

L. Proposed Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.

B. Coordinate and verify that related Work meets following requirements before beginning installation

1. Concrete surfaces are finished as acceptable for system to be installed.
2. Curing compounds used on concrete surfaces are compatible with system to be installed.
3. Concrete surfaces have completed proper curing period for system selected.

3.2 PREPARATION

A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

B. Correct unsatisfactory conditions before installing sealant system.

C. Acid etching is prohibited.

D. Grind joint edges smooth and straight with beveled grinding wheel before sealing. All surfaces to receive sealant shall be dry and thoroughly cleaned of all loose particles, laitance, dirt, dust, oil, grease or other foreign matter. Obtain written approval of method from system manufacturer before beginning cleaning.

E. Final preparation of joints shall be a sandblast with medium that removes dust and ground material from surfaces to receive sealant.

F. Check preparation of substrate for adhesion of sealant.

G. Prime and seal joints and protect as required until sealant is fully cured. A primer coat is required for all systems.

3.3 INSTALLATION/APPLICATION

A. Do all Work in strict accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions (including relative humidity and temperature), thicknesses and texture, and as shown on Drawings.

B. Completely fill joint without sagging or smearing onto adjacent surfaces.

C. Fill horizontal joints slightly recessed to avoid direct contact with wheel traffic.

D. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

E. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40ºF.

3.4 FIELD QUALITY CONTROL

A. Contractor and Engineer/Architect will jointly determine which one of following 2 methods of sealant testing to verify sealant profile:

1. Contractor, at Engineer/Architect's direction, shall cut out lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer/Architect and Manufacturer's Representative inspection of sealant profile.
2. Contractor, at Engineer/Architect's direction, shall install 3 trial joint sections of 20 ft each. Contractor shall cut out joint sections, as selected by Engineer/Architect, for Engineer/Architect and Manufacturer's Representative inspection. Additional isolated/random removals may be required where sealant appears deficient. Total cut out sealant shall not exceed lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer/Architect and Manufacturer's Representative inspection of sealant profile.
3. Perform sealant adhesion pull testing per manufacturer’s recommendations. Installer shall perform ten (10) tests for the first 1,000 LF of sealant installed along each area on each floor between sealant and substrate.
4. Installer shall provide weekly inspection log verifying all locations have been inspected and are free of installation defects or damage. Log should include specific locations and repairs performed. Log should be submitted to Contractor, Architect, Owner and BECxA.

B. Repair all random joint sealant "cut out" sections at no cost to Owner.

C. Testing Agency (paid by Contractor):

1. Check shore hardness per ASTM standard specified in sealant manufacturer's printed data.
2. If flood test of joints required by this Section, report results to Engineer/Architect.

END OF SECTION

SECTION 07 92 19 - ACOUSTICAL JOINT SEALANTS

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 (including all sustainability requirements), apply to this Section.

1.2 SUMMARY

A. Section includes acoustical joint sealants.

B. Related Requirements:

1. Section 07 92 00 "Joint Sealants" for elastomeric, latex, and butyl-rubber-based joint sealants for nonacoustical applications.

1.3 ACTION SUBMITTALS

A. Product Data: For each acoustical joint sealant.

B. Sustainable Design Documentation Submittals: Refer to section 01 81 13.14 “Sustainable Design Requirements – LEED V4 BD+C”.

1. Product Data: Documentation for Low Emitting Materials
   a. Low Emitting Materials for Adhesives and Sealants
2. Product Certificates: Provide the following:
   a. Environmental Product Declarations (EPD’s)
   b. Health Product Declarations (HPD’s)

C. 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.

D. Samples for Verification: For each kind and color of acoustical joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Acoustical-Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of acoustical joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Sample Warranties: For special warranties.

1.5 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace acoustical 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.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

B. Sustainability Requirements

1. Low Emitting Sealants
   a. Provide manufacture statements that confirm that the product used meets the California Department of Public Health (CDPH) Standard Method v1.1 2010 using the applicable exposure scenario.
   b. Refer to Section 01 81 13.14 “Sustainable Design Requirements - LEED v4 BD+C” for additional requirements.
2. Health Product Declaration: Provide Health Product Declaration with full disclosure of known hazards in compliance with the Health Product Declaration Open Standard
3. Environmental Product Disclosure: Provide an Environmental Product Declarations (EPD) that conforms with one of the following:
   a. Product specific declarations in accordance with ISO 1404
   b. Environmental Product Declarations conforming to ISO 14025, 14040, 14044 and EN 15804 or ISO 21930
   c. Industry Wide Product Specific Type III EPD Third Party Certification

2.2 ACOUSTICAL JOINT SEALANTS

A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard paintable, nonsag, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber acoustical sealant.

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. Acoustical Surfaces, Inc., AS-29 AcoustiSeal Acoustical Sealant
   b. Henkel Corporation, OSI SC175 Acoustical Sound Sealant
   c. Saint-Gobain Ceramics & Plastics, Inc., Green Glue Noiseproofing Sealant.

2.3 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.

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 acoustical joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer. 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 or primer 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 ACOUSTICAL JOINT SEALANTS

A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

3.4 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 acoustical joint sealants and of products in which joints occur.

A. Reference Specification 01 74 23 for additional requirements.

3.5 PROTECTION

A. Protect acoustical 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, remove, and repair damaged or deteriorated acoustical joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 19

SECTION 07 9501 - EXPANSION CONTROL - PARKING GARAGE

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. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:

1. Division 07 Section, “Traffic Coatings (Parking Garage)”
2. Division 07 Section, “Water Repellents (Parking Garage)”
3. Division 07 Section, “Joint Sealants (Parking Garage)”
4. Division 07 Section, “Expansion Control (Parking Garage)”

B. This Section includes the following:Standard expansion joint systems for open Air areas:

a. Elastomeric concrete edged, extruded rubber joint system

b. Reinforced rubber pad (nosepad), blockout mounted, mechanically anchored extruded rubber joint system

c. Extruded neoprene closed cell rubber joint system.

2. Pedestrian rated hinged cover plate system

C. Related Sections: The following Sections contain requirements that relate to this section:

1. Division 03 Section "Cast-in-Place Concrete (Parking Garage)."
2. Division 04 Section "Concrete Unit Masonry."
3. Division 07 Section "Fire-Resistive Joint Systems Firestopping”
4. Division 07 Section "Joint Sealants (Parking Garage)."
5. Division 07 Section “Interior Expansion Joint”
6. Division 09 Section “Painting (Parking Garage).”

1.3 DEFINITIONS

A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage (plus or minus) of nominal value of joint width. Movement capability is to include anticipated movements from concrete shrinkage, concrete shortening and creep from post-tensioning or prestressing, cyclic thermal movements, and seismic movements.

D. Nominal Joint Width: Width of linear opening specified in practice and in which joint system is installed.

E. Nominal Form Width: Linear gap in joint system at time of forming or erection of structural elements bounding the expansion joint.

F. Service Load Level: Defined level of load under which joint assembly remains elastic and fully functional.

G. Fatigue Load Level: Defined level of load under which joint assembly remains elastic and fully functional, including all noise mitigation components, for the stated number of cycles.

H. Collapse Load Level: Defined level of load under which joint assembly remains capable of bridging the gap, although plates may yield and components may break.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. General:

a. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

b. Coordinate requirements for transitions, tolerances, levelness, and plumbness to ensure the installed expansion joint system can perform with expected movement capabilities.

c. Coordinate and assign responsibility for preparation of concrete surfaces adjacent to expansion joints.

d. Expansion joint surface areas each side of joint gap shall have a vertical differential less than ¼” and meet requirements of expansion joint manufacturer.

e. Minor surface defects shall be repaired according to manufacturer’s recommendations. Repair materials shall be compatible with intended system materials and shall be approved by the Engineer prior to surface preparation and installation.

f. Submit for approval repair products and procedures for all major defects. Repair description shall indicate materials, manufacturer’s requirements, expected service life, and maintenance requirements. Take all precautions necessary to avoid damaging adjacent surfaces and embedded reinforcement or post tensioned anchors and tendons. Contractor is responsible for any damages. Concrete repairs shall be of rectangular configuration, with no feather-edged surfaces. Final surface preparation of all repairs shall be sandblasting, or approved equivalent.

g. Coordinate layout of joint system and approval of methods for providing joints.

2. Joint Opening Width:

a. Use temperature adjustment table to properly size joint gap at time of concrete pour and show that proposed joint system is capable of equal individual and combined movements in each direction when installed at designated temperature shown on drawings.

b. Where installation temperature is other than specified temperature, perform calculations showing joint is capable of movement within design temperature range (Criteria on Drawings) for “other” temperature, and that design and installation follow manufacturer’s recommendations.

c. Expansion joint movement capability and the actual joint gap movement may not coincide. Construct actual joint gap in accordance with expansion design criteria.

3. Blockouts:

a. Float expansion joint blockouts to remove all air pockets, voids and spalls caused by form work.

b. Blockouts shall be plumb with maximum tolerance per Manufacturer or not more than 0.125 inches deviation in 12 inches. Noncompliant blockouts shall be considered major defects.

c. Blockouts shall be straight and true with maximum tolerance per Manufacturer or not more than 0.250 inches deviation in 10 lineal feet. Noncompliant blockouts shall be considered major defects.

B. Preinstallation Meetings: Meet at project site well in advance of time scheduled for Work to proceed to review requirements for Work and conditions that could interfere with successful expansion joint system performance. Require every party concerned with concrete formwork, blockout, concrete placement, or others required to coordinate or protect the Work thereafter, to attend. Include Engineer of Record and manufacturer's technical representative and warranty officer.

C. Make submittals in accordance with requirements of Division 01 Section, “Shop Drawings, Product Data, and Samples~~Submittal Procedures~~:”

1. See requirements of Division 01 Section, “Shop Drawings, Product Data, and Samples~~Submittal Procedures~~,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.
2. See requirements of Division 01 Section, “Shop Drawings, Product Data, and Samples~~Submittal Procedures~~,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.5 ACTION SUBMITTALS

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

1. Construction details, material descriptions, dimensions, and finishes.
2. Proposed method of preparation of concrete surface to receive expansion joint systems.
3. Proposed method and details for treatment of cracks, bugholes, or other potential concrete surface defects in areas to receive expansion joint systems.
4. Horizontal spacing between embedded metals and plates to allow for volume change due to thermal conditions.

5. Temperature adjustment table showing formed gap at the time of concrete placement calculated at 10°F increments and a calculation showing joint system is capable of movement within the design temperature range.

B. Shop Drawings: For each type of product indicated:

1. Placement Drawings: Show project conditions including, but not limited to, line diagrams showing plans, elevations, sections, details, splices, blockout requirement, and terminations. Provide isometric or clearly detailed drawings depicting how components interconnect. Include reviewed and approved details from others whose work is related. Other information required to define joint placement or installation.
2. Joint System Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
    a. Manufacturer and model number for each joint system.
    b. Joint system location cross-referenced to Drawings.
    c. Form width.
    d. Nominal joint width.
    e. Movement capability.
    f. Minimum and maximum joint width.
    g. Classification as thermal or seismic.
    h. Materials, colors, and finishes.
    i. Product options.
    j. Fire-resistance ratings.
3. Components and systems required to be designed by a professional engineer, shall bear such professional’s written approval when submitted.

C. Samples:Samples for each type of joint system indicated.

    a. Submit 2 samples for each type. Full width by 6 inches (150 mm) long, for each system required.

2. Develop mockups of concrete surface preparation for review and to establish a control for the application.
3. Provide a complete mockup for each exterior expansion joint representative of the most challenging project conditions reviewed and approved by manufacturer in writing. The mock-up can be left in place as part of the permanent construction if accepted by the architect.

D. Delegated Design Submittals:

1. Analysis indicating expansion joint system complies with expansion joint performance and design criteria of this specification and is suitable for use in conditions of this project. Provide a summary of design criteria used in design.

E. Test and Evaluation Reports:Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for current products.

F. Product Certificates: Refer to section 01 8113.14 “Sustainable Design Requirements – LEED V4 BD+C” for the following: Required for all areas.

a. Environmental Product Declarations (EPD’s)

b. Health Product Declarations (HPD’s)

G.

1.6 INFORMATIONAL SUBMITTALS

A. Certificates

1. Certification that products and installation comply with applicable federal, state of Florida, and local EPA, OSHA and VOC requirements regarding health and safety hazards and project LEED requirements.
2. ADA Certification: Prior to installation, submit written certification from manufacturer indicating that expansion joints conform to Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1-800-872-2253.

a. Submit test reports from accredited laboratory attesting to joint systems’ movement capability and ADA compliance.

b. Static coefficient of friction shall meet minimum requirements of Americans with Disabilities Act (ADA).

3. Signed statement from installer/applicator certifying that installer/applicator has read, understood, and shall comply with all requirements of this Section.
4. Signed statement from manufacturer’s representative that they have read, understood, and shall comply with all requirements of this section.

B. Field Quality Control

1. Two copies each of manufacturer's technical representative's log for each visit.

C. Qualification Statements

1. Manufacturer’s qualifications as defined in the “Quality Assurance” article within 60 days of project award.
2. Installer’s qualifications as defined in the “Quality Assurance” article.
3. Evidence of manufacturer’s certification of installer/applicator. Evidence shall include complete copy of manufacturer’s licensing/certification document, spelling out repair responsibility for warranty claims.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Contracts: 2 copies of Maintenance Program contracts.

B. Operation and Maintenance Data

1. Maintenance Manual: 2 copies of System Maintenance Manual.

2. "Submit one (1) copy of the O&M in PDF format on CD-ROM. Create a PDF file for each section of the manual. PDF files shall be named BPXXX OM Sec XXXX.pdf".

C. Warranty Documentation: 2 executed copies of Labor and Material Warranty including all terms, conditions and maintenance requirements.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of compliance with Experience Record and Qualifications paragraph below.
2. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
3. Copy of sample warranty that meets the requirements of the “Warranty” article in Section 1.
4. Evidence of financial stability acceptable to Owner or Engineer/Architect.
5. Evidence of compliance with "Single Installer" requirement.

B. Experience Record and Qualifications: Verification of systems shall be established by either System Validation or Design Validation.

1. System Validation: Submitted system for similar applications with minimum five (5) years experience and five (5) verified projects completed. Validation submittal shall include:

   a. Sealed design calculations by an engineer licensed in Florida, including finite element analysis for all structural load carrying elements, using the design criteria listed in Part 2.

   b. Field history as defined below.

2. Design Validation: Submitted system for similar application with less than five (5) years experience shall include a design validation submittal. Validation submittal shall include:

   a. Sealed design calculations by an engineer licensed in Florida, including finite element analysis for all structural load carrying elements, using the design criteria listed in Part 2.

   b. Results of cyclic and seismic load tests defined below.

3. Acceptable field history consists of successful performance of five (5) installations in place over the previous five (5) years under similar project loads, traffic frequency, footprints, and joint sizes. Include sketches, photos, and references for each installation. Installations shall have experienced at least moderate levels of traffic.
4. Vertical and horizontal cyclic load tests shall be performed at an independent laboratory, and witnessed by a professional engineer licensed in the State of Florida, who shall issue a sealed final report of the test results. Tests shall consist of cyclic load testing using the design criteria in Part 2 and project joint sizes. Tests shall meet the following criteria:

   a. Vertical load cycle counts shall be a minimum of 2, 1000, and 1,000,000 cycles for the collapse, service, and fatigue level loads respectively.

b. Horizontal load cycle counts shall be a minimum of 1,000 and 25,000 cycles for the service and fatigue level loads respectively. No horizontal load test is required for the collapse level loads.

c. The vertical service and fatigue load test shall consist of a rolling tire at specified load in order to gauge joint wear. Test specimen shall show no signs of yielding of load carrying elements.

d. Observation and testing results of performance for noise mitigation elements shall be reported.

e. Different specimens may be used for the tests if they are of the same size and design. Conditions adjacent to the joint, e.g. the blockout region, shall be in keeping with the system design. Test joints shall be not less than 4 feet per tire in length, and shall replicate typical field installed geometry.

C. Installer Qualifications: An employer of workers, including superintendent for this project, trained and approved by manufacturer.

D. Testing Agency: Independent testing laboratory employed by Contractor and acceptable to Engineer/Architect.

E. Certifications

1. Provide reports to Owner detailing maintenance activities have been performed in accordance with written maintenance agreement for expansion joints.
2. Materials shall be compatible with materials or related Work with which they come into contact and the related materials sections.
3. Manufacturer/Applicator: Review and approve all details before construction. Confirm in writing to Owner.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

1.10 WARRANTY

A. Warranty period shall be a 5 year labor and materials warranty commencing with date of acceptance of work.

B. Installation Requirements: Include a written plan of construction and coordination requirements, to allow joint system installation to proceed with specified warranty, that specifically addresses the following:

1. Block out acceptance criteria.

2. Surface preparation acceptance criteria.
3. Crack, surface defect, and detailing recommendations.
4. Method of protection of surrounding surfaces.
5. Method of expansion joint system installation description.
6. Primer type and application rate.
7. Method of preparation of all glands and reinforced membranes.
8. Temperature, humidity and other weather constraints. Specify substrate moisture testing criteria, if any.
9. Final cure time before removal of protection, resumption of traffic, and/or paint striping.
10. Any other special instructions required to ensure proper installation.

C. Quality Service Requirements: Show evidence of licensed/approved installer. List of names, addresses and phone numbers, with copies of certification/approval agreement with each, satisfies requirement. Licensing/certification agreement shall include following information:

1. Installer's financial responsibility for warranty burden under agreement terms.
2. Manufacturer's financial responsibility for warranty burden under agreement terms.
3. Process for dispute settlement between manufacturer and installer in case of system failures where cause is not evident or cannot be assigned.
4. Authorized signatures for both Installer Company and Manufacturer.
5. Commencement date of agreement and expiration date (if applicable).
6. Provide copy of contractor's field application quality control procedures.

D. Warranty shall be jointly executed by Manufacturer and Installer for labor and materials. Detail responsibilities of General Contractor, manufacturer and installer with regard to warranty requirements, as outlined in the Manufacturer's warranty and related Licensing/Certification documents. Warranty shall provide that system shall be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any water leakage through expansion joint system or leaking conditions of reinforced membrane, other waterproofing components, or glands.
2. Any adhesive or cohesive failures of the system.
3. Shifting of plates out of alignment due to system failure.
4. Loose plates, anchor blocks, bolts.
5. Metal to metal vibration causing noises during use.
6. Metal to non-metal vibration causing noises during use.
7. Tears, weathering, or degradation in gland from normal use.
8. Expansion joint glands are considered defective if they buckle upwards beyond the level of the floor surface after installation or downward in excess of ½ inch below the floor surface.

E. If expansion joint systems or components show any of defects listed above, supply labor and material to repair all defects at no cost to Owner.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. A single Installer shall be responsible for providing complete expansion joint system. Obtain all joint systems through one source from a single manufacturer.

B. Drawings indicate size, profiles, and dimensional requirements of joint systems and are schematic for systems indicated.

C. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2.2 PERFORMANCE REQUIREMENTS

A. Intent of this section is to insure that installed expansion joints allow pedestrian and vehicular traffic to pass in a smooth, quiet fashion with minimal maintenance required over a period of not less than 10 years. Expansion joints shall not only function as structural bridging elements, but must also accommodate structural expansions/contractions and minimize water leakage.

B. Provide design of expansion joint for preparation of final details for fabrication and construction of all concrete openings, expansion joint elements and required accessories. An integral part of this project is engineering for the following:

1. Include calculations for the size and forming of concrete openings to provide nominal joint width as indicated on drawings. Provide a summary of the design criteria used in the design.
2. Include calculations for the appropriate size of expansion joint elements in accordance with the expansion joint assembly performance criteria. Include installation requirements of expansion joint assembly for specific project conditions and scheduling. Provide a summary of design criteria used in design.

C. Expansion joint design shall meet or exceed all expected movements shown on drawings.

D. Installation temperature range and estimated volume change movements are shown on drawings. Nominal form width shown on the drawings shall be adjusted for the ambient temperature at time of concrete placement and designer shall verify that width of joint at installation shall meet minimum installation requirements.

E. Expansion joint systems shall be capable of resisting a differential vertical movement of ½ inch.

F. Materials shall be supplied in lengths to minimize or eliminate the need to splice waterproofing components.

1. Waterproofing materials directly exposed to vehicular traffic shall be supplied with no joints in vehicle drive aisles.
2. All mitered splices shall be performed at the factory and provide sufficient gland length for butt splicing with field splicing equipment.
3. All Santoprene butt to butt splices shall be heat welded.
4. Butt to butt splices with other materials shall be per manufacturer’s recommendations.

G. Fire-Test-Response Characteristics: Where indicated, provide expansion joint system and fire-barrier assemblies identical to those of assemblies tested for fire

resistance per UL 2079 by a testing and inspecting agency acceptable to authorities having jurisdiction.

H. Walking Surfaces: Expansion joint assemblies at walking areas subject to pedestrian traffic shall provide a smooth, slip resistant walking surface for pedestrians with these minimum requirements:

1. Shall provide walking surfaces in accordance with ASTM – F 1637 Standard Practice for Safe Walking Surfaces.
2. Shall be designed to comply with “Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)”. Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1–800-872-2253.
3. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:
    a. Changes in level of less than ¼ inch in height may be without edge treatment as shown in ADA Figure 303.2 and on the Drawings.
    b. Changes in Level between ¼ inch and ½ inch in height shall be beveled with a slope no greater than 1:2 as shown in ADA Figure 303.3 and on the Drawings.
    c. Changes in level greater than ½ inch in height are not permitted unless they can be transitioned by means of a ramp as shown on Drawings.
    d. Openings in floor or ground surfaces shall not allow passage of a sphere more than ½ inch diameter except as allowed for elevators and platform lifts as shown in ADA Figure 302.3 and on the Drawings.

2.3 MANUFACTURERS

A. Subject to compliance with requirements, provide products from one of following manufacturers (listed in alphabetical order), only where specifically named in product categories:

1. Balco Inc., Wichita, KS (Balco).
2. Construction Specialties, Inc., Muncy, PA (C/S).
3. Dow Corning Corp., Midland, MI (Dow Corning).
4. Emseal Joint Systems, Westborough, MA (Emseal).
5. Erie Metal Specialties, Inc., Akron, NY (EMS).
6. Lymtal International Inc. Lake Orion, MI (Lymtal).
7. MM Systems Corporation, Atlanta, GA (MM).
8. TechStar, Inc., Findlay, OH (TechStar).
9. Tremco, Cleveland, OH (Tremco).
10. Watson Bowman Acme Corporation, a Division of BASF Construction Chemicals NA, Amherst, NY (WBA).

2.4 PRODUCTS, STANDARD EXPANSION JOINT SYSTEMS

A. Elastomeric concrete edged, extruded rubber expansion joint system.

1. DuraFlex Chambered Wing Seal CS and DCS Seris, Balco.
2. Iso-Flex Winged Joint System J Series, LymTal.

3. Lokcrete Membrane System (LMS) Series, MM.
4. Polycrete/Membrane System, Type CR Series, EMS.
5. Thermaflex Membrane/Nosing System, Type TM and TCR Series, Emseal.
6. Vulkem WF series Vehicular Expansion Joint System, Tremco.
7. Wabo®Crete Membrane System ME Series, WBA.
8. ZB 200/400 Series, C/S.

B. Reinforced rubber pad (nosepad), blockout mounted, mechanically anchored expansion joint sealant system.

1. C/S Neoprene Anchor Block System, Model CSAB, C/S.
2. DuraFlex™ Rubber Block RB Series, Balco.
3. ElastoLok Membrane System, EMS Series, MM.
4. Iso-Flex Dura-Block System, Lymtal.
5. Wabo®ElastoFlex Expansion Joint System with EFJ Series gland element, WBA.

C. Extruded Neoprene closed cell rubber expansion joint for vertical applications, stair towers, columns, perimeter floor-to-wall joints.

1. DuraFlex™ Flex Seal FS Series, Balco.
2. Expanded Rubber Sealing System, ERS Series, MM.
3. Iso-Flex Foamflux Joint Seal, LymTal.
4. Wabo®InverSeal, WBA.

D. Field applied silicone sealant expansion joint system:

1. Dow Corning FC parking structure sealant (fast cure), Dow Corning.
2. Wabo®SiliconeSeal Two-Part Silicone, WBA.

E. Substitutions: None for this project. Contact Engineer/Architect for consideration for future projects.

2.5 PRODUCTS, OTHER

A. Neoprene foam rubber vertical expansion joint sealants:

1. Wabo®InverSeal, WBA.
2. Iso-Flex Foamflux, LymTal.
3. Expanded Rubber Sealing System, ERS Series, MM.

B. Vertical compression joint sealants:

1. Elastoprene Compression Seals, ECS & VCS Series, MM.
2. Iso-Flex Compression Seal, LymTal.
3. Wabo®CompressionSeal, WBA.

C. Expanding foam sealants:

1. ColorJoint Silicone Sealing System, ESS Series, MM.
2. 25V, (black) Emseal.
3. Seismic Colorseal, Emseal.
4. Colorseal, (colored), Emseal.
5. Iso-Flex Precom “C”, LymTal.
6. Iso-Flex Precom “V”, LymTal.

D. Pedestrian Rated Hinged Cover Plate System, aluminum and stainless steel plates that provide flexible cover plate across stair and elevator tower expansion joint openings:

1. Iso-Flex Hinged Cover Plate PD Series, LymTal.
2. C/S Hinged Cover System, Model PD, PDW, C/S.
3. Hinged Safety Cover System, HSC Series, MM.
4. Wabo Safety Flex, SFP, with Molded Elastomeric Plate, WBA.

E. Secondary Moisture Containment System, flexible fabric reinforced membrane made of either polychloraprene or EPDM. System to provide a drain gutter that drains excess moisture through a flexible tube:

1. Iso-Flex Drain Guard, LymTal.
2. C/S Waterstop, C/S.
3. Flexible Gutter System, FGS Series, MM.
4. DuraFlex™ EPDM Water Barrier System, Balco.
5. Wabo GutterFlex, WBA.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and blockouts where expansion joint systems will be installed for installation tolerances and other conditions affecting performance of Work.

B. Check elevations on each side of expansion joint gap to ensure flush slab-to-slab transition.

C. Check anticipated or actual minimum and maximum joint openings. Compare to manufacturer's movement specifications and make joint sizing recommendations.

D. Coordinate and verify that related Work meets following requirements:

1. Check adhesion to substrates and recommend appropriate preparatory measures.
2. Curing compounds used on concrete surfaces are compatible with Work to be installed.
3. Concrete surfaces have completed proper curing period for system selected.
4. Coordinate expansion joint system with other related Work before installation of expansion joint.
5. Verify expansion joints are compatible with Joint Sealants and traffic toppings.

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

F. Cease installation if expansion joint blockouts and/or openings exhibit cracked edges, voids or spalls. Repair with approved material prior to installation of expansion joint.

G. Correct unsatisfactory conditions in manner acceptable to Manufacturer and Engineer before installing joint system.

3.2 PREPARATION

A. Prepare for installation of expansion joint systems in accordance with manufacturer's recommendations

B. Surface Preparation:

1. Acid etching: Prohibited.
2. Prepare substrates according to joint system manufacturer's written instructions.
3. Clean joints thoroughly in accordance with manufacturer's instructions to remove all laitance, unsound concrete and curing compounds which may interfere with adhesion.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing joint assemblies and materials unless more stringent requirements are indicated.

B. Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

C. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturers recommended limitations for installation, or when temperature of work area or substrate are below 40ºF.

D. Terminate exposed ends of joint assemblies with field- or factory-fabricated termination devices.

E. Seal all openings to occupied spaces to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

F. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturer.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Prior to opening to traffic, test joint seal for leaks by maintaining continuously wet for 12 hours. Repair leaks revealed by examination of seal underside. Repeat test and repairs until all leaks stopped for full 12 hours.

B. Manufacturer Services: Provide qualified manufacturer’s technical representative for periodic inspection of Work at critical time of the installation, including but not limited to pre-concrete formwork and placement site meetings, block out inspection, surface defect repair, surface preparation, metal work, expansion gland installation and waterproofing system installation.

C. Installer shall provide weekly inspection log verifying all locations have been inspected and are free of installation defects or damage. Log should include specific locations and repairs performed. Log should be submitted to Contractor, Architect, Owner and BECxA.

3.5 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of Work.

END OF SECTION