ITEM NO. 871S - REFLECTORIZED PAVEMENT MARKINGS 6-21-07

871S.1 - Description

This item shall govern furnishing and placement of reflectorized pavement markings of the colors, types, shapes, sizes, widths and thickness indicated on the Drawings.

871S.2 - Materials

A. Type I Marking Material.

Type I markings are thermoplastic type materials that require heating to elevated temperatures for application. Type I marking materials shall conform to TxDOT Departmental Materials Specification Item DMS-8220, "Thermoplastic Pavement Markings". Each container of Type I Marking Material shall be clearly marked to indicate the color, weight (mass), type of material, manufacturer's name and lot/batch number.

B. Source of Supply.

All Type I marking materials shall be purchased on the open market. 871S.3 - Equipment Requirements

The equipment used to place pavement markings shall:

A. be maintained in satisfactory operating condition;

B. have production capabilities considered satisfactory by the Engineer or designated representative, when used to place markings other than solid or broken lines;

C. be capable of placing lines with clean edges and of uniform cross-section. All lines shall have a tolerance of plus or minus 1/8 inch per 2-inch width (3 mm per 100-mm width);

D. have an automatic cut-off device with manual operating capabilities to provide clean, reasonably square marking ends to the satisfaction of the Architect.;

E. provide continuous mixing and agitation of the pavement marking material. The use of pans, aprons or similar appliances, which the die overruns, will not be permitted for longitudinal striping applications;

F. apply beads by an automatic bead dispenser attached to the pavement marking equipment in such a manner that the beads re-dispensed uniformly and almost instantly upon the marking as the marking is being applied to the road surface. The bead dispenser shall have an automatic cut-off control, synchronized with the cut-off of the pavement marking equipment. 871S.4 - Construction Methods

A. General.

When required by the Engineer, the Contractor and the Engineer shall review the sequence of Work to be followed and the estimated progress schedule.

Guides to mark the lateral location of pavement markings shall be established as shown on the Drawings or as directed by the Engineer or designated representative. The Contractor shall establish the pavement marking guide and the Engineer or designated representative will verify the location of the guides.

Markings shall be placed in proper alignment with the guides. The maximum deviation shall not exceed 2 inches (50 millimeters) nor shall any deviation be abrupt.

Markings shall essentially have a uniform cross-section. The density and quality of markings shall be uniform throughout their thickness. The applied markings shall have no more than five (5) percent, by area, of holes or voids and shall be free of blisters.

Contractor personnel shall be sufficiently skilled in the Work of installing pavement markings.

Markings placed that are not in alignment or sequence, as shown on the drawings or as stated in the Standard Specification Item, shall be removed by the Contractor at its own expense. Guides placed on the street for alignment purposes shall not establish a permanent marking on the street.

Unless indicated otherwise on the Drawings, pavement markings shall not be placed sooner than 3 calendar days after the placement of concrete surface course or surface treatment.

Unless otherwise shown on the Drawings, pavement markings may be applied by any method that will yield markings meeting the requirements of the Specification Item.

B. Surface Preparation.

New Portland cement concrete surfaces shall be cleaned in accordance with Specification Item 875S, "Pavement Surface Preparation for Markings" to remove curing membrane, dirt, grease, loose and/or flaking existing construction markings and other forms of contamination.

Pavement to which material is to be applied shall be completely dry. Pavements shall be considered dry if, on a sunny day after observation for 15 minutes, no condensation occurs in the underside of a 1 foot (300 mm) square piece of clear plastic that has been placed on the pavement and weighted on the edges.

C. Application of Type I Markings.

New Portland cement concrete surfaces shall be further prepared for Type I markings, after cleaning, by placing a Type II marking as a sealer in accordance with the Specification Item. When placing Type I markings in new locations on asphaltic surfaces 3 years old or older or any Portland cement concrete surfaces, a Type II marking shall be used as a sealer. Unless otherwise shown on the Drawings, existing Portland cement concrete and asphaltic surfaces to be restriped will not require Type II markings as a sealer; existing markings may be used as a sealer in lieu of Type II markings. Type II markings shall be placed a minimum of 2 and a maximum of 30 calendar days in advance of placing Type I markings. Type II markings which become dirty due to inclement weather or street conditions shall be cleaned by washing, brushing, compressed air or other means approved by the Engineer, prior to application of Type I markings. If washing is used, the surface of Type II markings shall become thoroughly dry before placing Type I markings. Color, location and configuration of Type II markings shall be the same as that of Type I markings.

Type I pavement marking material shall be applied within temperature limits recommended by the material manufacturer.

When Type I pavement marking application is by spray, and operations cease for 5 minutes or more, the spray head shall be flushed by spraying pavement marking material into a pan or similar container until the pavement marking material being sprayed is at the proper temperature for application.

Unless otherwise directed by the Engineer in writing, Type I pavement-marking materials shall not be placed on streets between September 30 and March 1, subject to temperature and moisture limitations specified herein.

Unless otherwise shown on the Drawings, the minimum thickness of Type I marking shall be 0.060 inches (60 mil) (1.5 millimeters) for edgeline markings and 0.090 inches (90 mil) (2.3 millimeters) for stop-bars, legends, symbols, gore and center-line/no-passing barrier-line markings, when measured in accordance with TxDOT Test Method Tex-854-B. The maximum thickness of all Type I markings shall be 0.180 inches (180 mil) (4.6 millimeters).

The thickness of Type I markings at the time of placement will be measured above the plane formed by the pavement surface. The Contractor will supply an approved device to measure the thickness of the applied markings. The markings shall be of uniform thickness throughout their lengths and widths.

871S.5 - Performance Period for Type I Markings

Type I pavement markings shall meet all the requirements of this technical specification for a minimum of 15 calendar days after installation. Pavement markings that fail to meet all requirements of this specification shall be removed and replaced by the Contractor at its own expense. The Contractor shall replace all pavement markings failing the requirements of this technical specification within 30 calendar days following notification by the Engineer or designated representative of such failing. All replacement markings shall also meet all requirements of this technical specification for a minimum of 15 calendar days after installation. 871S.6 - Measurement

This Specification Item will be measured by the lineal foot (lineal meter), by each of the various words, shapes or symbols, or by any other unit as shown on the Drawings.

Where double stripes are placed, each stripe will be measured separately.

Final work zone pavement markings (paint and beads), which will be used as a sealer for Type I pavement markings, will not be measured for payment. 871S.7 - Payment

The work performed and materials furnished in accordance with this Standard Specification Item and measured as provided under "Measurement" will be paid for at the Unit bid price for "Reflectorized Pavement Markings" of the various types, colors, shapes, sizes, widths and thickness (Type I markings only) specified. This price shall include full compensation for furnishing all materials; for application of pavement markings; and for all other labor, tools, equipment and incidentals necessary to complete the Work, except as described below.

Surface Preparation, when indicated on the Drawings, will be paid for under Specification Item 875S, "Pavement Surface Preparation for Markings."

Final work zone pavement markings (paint and beads), which will be used as a sealer for Type I pavement markings, shall be included in the unit price bid for the item of construction for which final work zone pavement markings are used.

Payment will be made under one or more of the following:

Original placement of Reflectorized Pavement Markings:

Pay Item 871S-A:	Reflectorized Type I Thermoplastic Pavement Markings 24 inches in width, 90 mils in thickness GREEN in color	per lineal foot.

END

SPECIFIC CROSS REFERENCE MATERIALS	
Specification Item No. 871S, "Reflectorized Pavement Markings"	
City of Austin Contract Documents	

Designation	Description
Section 00300U	Bid Form (Unit Price)

City of Austin Standard Specifications

Designation	Description
Item No. 320S	Two Course Surface Treatment
Item No. 860S	Pavement Marking Paint (Reflectorized)
Item No. 874S	Eliminating Existing Pavement Markings and Markers
Item No. 875S	Pavement Surface Preparation For Markings

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex-828-B	Determining Functional Characteristics of Pavement Markings
Tex-829-B	Method For Measuring Pavement Temperature
Tex-854-B	Evaluation Of Thermoplastic Striping For Uniformity And Thickness

RELATED CROSS REFERENCE MATERIALS

Specification Item No. 871S, "Reflectorized Pavement Markings"

City of Austin Standard Specifications

Designation	Description
Item No. 301S	Asphalts, Oils and Emulsions
Item No. 302S	Aggregates for Surface Treatments
Item No. 310S	Emulsified Asphalt Treatment
Item No. 311S	Emulsified Asphalt Repaving
Item No. 312S	Seal Coat
Item No. 313S	Rubber Asphalt Joint and Crack Sealant
Item No. 315S	Milling Asphaltic Concrete Paving
Item No. 340S	Hot Mix Asphaltic Concrete Pavement
Item No. 341S	Paving Fabric
Item No. 350S	Heating, Scarifying and Repaving
Item No. 360	Concrete Pavement
Item No. 801S	Construction Detours
Item No. 803S	Barricades, Signs and Traffic Handling
Item No. 863S	Reflectorized Pavement Markers
Item No. 864S	Abbreviated Pavement Markings
Item No. 865S	Nonreflectorized Traffic Buttons
Item No. 866S	Jiggle Bar Tile
Item No. 867S	Epoxy Adhesive
Item No. 870S	Work Zone Pavement Markings

Item No. 872S	Prefabricated Pavement Markings
Item No. 873S	Raised Pavement Markers
Item No. 863S-1	Pavement Buttons (Reflectorized-Type I & Type II)
Item No. 865S-1	Traffic Buttons (Non-Reflectorized)

Texas Department of Transportation: Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges

Designation	Description
Item No. 302	Aggregates for Surface Treatments
Item No. 314	Emulsified Asphalt Treatment
Item No. 315	Emulsified Asphalt Seal
Item No. 316	Surface Treatments
Item No. 334	Hot Mix-Cold Laid Asphaltic Concrete Pavement
Item No. 340	Hot Mix Asphaltic Concrete Pavement
Item No. 342	Plant Mix Seal
Item No. 351	Repairing Existing Flexible Pavement Structure
Item No. 354	Planing and/or Texturing Pavement
Item No. 358	Asphaltic Concrete Surface Rehabilitation
Item No. 360	Concrete Pavement
Item No. 421	Hydraulic Cement Concrete
Item No. 427	Surface Finishes for Concrete

Item No. 428	Concrete Surface Treatment
Item No. 662	Work Zone Pavement Markings
Item No. 666	Reflectorized Pavement Markings
Item No. 667	Prefabricated Pavement Markings
Item No. 672	Raised Pavement Markers
Item No. 677	Eliminating Existing Pavement Markings and Markers
Item No. 678	Pavement Surface Preparation For Markings

Texas Department of Transportation: Manual of Testing Procedures

Designation	Description
Tex 729-I	Sampling of Traffic Markers

Texas Department of Transportation: Departmental Materials Specifications

Designation	Description
DMS-4100	Jiggle Bar Tile
DMS-4200	Pavement Markers (Reflectorized)
DMS-4300	Traffic Buttons
DMS-4210	Pavement Markers
DMS-6130	Bituminous Adhesive
DMS-8200	Pavement Paint

DMS-8220	Thermoplastic marking material
DMS-8240	Prefabricated Marking Materials
DMS-8241	Removable Tape
DMS-8290	Pavement Paint
YPT-10 and/or WPT-10	Pavement Paint

SECTION 031000 - CONCRETE FORMWORK

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation for formwork and related accessories required to complete all cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Concrete Reinforcement and Embedded Assemblies	Section 032000
Cast-in-Place Concrete	Section 033000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:
1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 237 – Self Consolidating Concrete.
3. ACI 301 –Specifications for Structural Concrete.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. ACI 347 – Guide to Formwork for Concrete.
6. ACI 347.2R – Guide for Shoring/Reshoring of Concrete Multistory Buildings

C. Definitions:
1. See Section 033000.

1.5 CONTRACTOR QUALIFICATIONS

A. The work of this section shall be performed by a company specializing in the type of concrete formwork required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workers thoroughly experienced in the necessary crafts.

B. Contractor's Testing Agency Services: Required as specified in Division 1, and herein.

C. Materials and installed work may require testing and retesting at any time during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.
(1) Submittal Schedule
(2) Shop Drawings
(3) Shoring/Reshoring Calculations
(4) Product Data
(5) Samples
(6) Compatibility Certification
(7) Hazardous Materials Notification

1. Submittal Schedule: See Section 033000.
2. Shop Drawings:
a) Submit for action: Formwork shop drawings sealed and signed by a Professional Engineer licensed in the state where the project is located. Shop drawings shall clearly indicate but not be limited to the following:

1. Size, type and quality of form materials including conditions at tops and ends of walls. (If wood is used, indicate species.)
2. Form construction indicating structural stability and jointing including special form joints or reveals required by Contract Documents
3. Location and pattern of form tie placement, and other items that affect the appearance of concrete that will remain exposed to view.
4. Form finish clearly indicating proper locations and full coordination with concrete finishes required by Contract Documents.
5. Layout, procedures, and sequencing of shoring and reshoring that correlates with the information contained in the shoring/reshoring calculations described below.
6. Locations and dimensions of openings in structural members including floor slab, shear walls, columns and beams. See SUBMITTALS Section of Specification 033000.
7. Location of proposed construction joints in walls, floors, slabs, and beams. See SUBMITTALS Section of Specification 033000.

3. Shoring/Reshoring Calculations: Submit for record. Calculations sealed and signed by a Professional Engineer licensed in the state where the project is located. Calculations shall clearly address but not be limited to the following:
   a) Shoring removal and reshoring installation procedure including timing and sequencing.
   b) Concrete age and strength at the time of each shoring/reshoring operation.
   c) Description of construction loads assumed including concrete, formwork, and construction live load in accordance with ACI 347.
   d) Description of the distribution of construction loads between the shored/reshored levels.
   e) Description of the distribution of construction loads during post-tensioning including the effects of stage stressing of post-tensioned members.
   f) The total construction load imposed on all levels supporting shoring/reshoring at each stage of the shoring/reshoring cycle.
   g) A written statement by the Professional Engineer that the total construction load imposed on any level supporting shoring/reshoring, at all stages of the shoring/reshoring cycle, accounting for concrete age and relative strength at time of loading, meets the requirement of Section 3.2.
4. Product Data: Submit for action copies of manufacturers' product data and installation instructions for proprietary materials used in exposed concrete work, including form liners, release agents, manufactured form systems, ties, and accessories.
5. Samples: At request of Architect, submit for record samples of form ties and spreaders.
6. Compatibility Certification: Submit for record a written statement certifying that form release agent used is compatible with subsequent architectural finish materials applied to concrete surfaces. Submit along with manufacturer's data.
7. Hazardous Materials Notification: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

B. Submittal Process: See Section 033000
C. SER Submittal Review: See Section 033000
D. Substitution Request: See Section 033000
E. Request for Information (RFI): See Section 033000

1.7 FORMWORK DESIGN

A. Design of Formwork, Shoring/Reshoring, and its removal is the Contractor’s responsibility.
B. Design, erect, support, brace and maintain formwork so that it will safely support vertical and lateral loads per SEI/ASCE 37-02 that might be applied, until such loads can be supported by the concrete structure.
C. Design Requirements:
   1. Forms shall be designed for fabrication and erection in accordance with Design Professionals’ requirements and recommendations of ACI 301, 318 and 347.
   2. Design formwork in a manner such that the total construction load does not at any time exceed the total design load of new or existing construction and accounts for concrete age and relative strength at time of loading. See Section 3.2 for shoring/reshoring requirements.
   3. Design formwork for loads and lateral pressures outlined in Section 2.2, ACI 347, and wind and seismic loads as specified by SEI/ASCE 37-02 unless otherwise controlled by local building code.
   4. Design formwork to include loads imposed during construction, including weight of construction equipment, concrete mix, height of concrete drop, rate of filling of formwork, vibrator frequency,

ambient temperature, foundation pressures, lateral stability, temporary imbalance or discontinuity of building components, and other factors pertinent to safety of structure during construction.

5. The use of flowing concrete (8" (200mm) to 10" (250mm) slump) of Self-Consolidating Concrete requires a review of the formwork design based on the rate of placement and setting time of the mix. Unless shown to be sufficient otherwise, formwork design shall conform to the requirements of ACI 237.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Conditions and Division 1, including the following:
   1. Store forms and form materials clear of ground and protect from damage.

1.9 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. Field Quality Assurance General: The Owner's Testing Agency shall test and inspect concrete formwork as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such a defect is discovered nor shall it obligate Design Professionals for final acceptance.

B. Testing Agency shall provide qualified personnel at site to inspect formwork using the latest Contract Documents and approved shop drawings as follows:
   1. Prior to placement of reinforcement, inspect formwork for grade, quality of material, absence of foreign matter, and other imperfections that might affect suitability of concrete placement and tolerances stated herein.
   2. Inspect forms for location, configuration, compliance with specified tolerances, block outs, camber, shoring ties, seal of form joints and compliance with Contract Documents.
   3. Verify condition of bond surfaces, locations and sizes of all accessories, embedment items, and anchorage for prevention of displacement.
   4. Verify proper use/application of form release agents.
   5. Inspect concrete surfaces immediately after removal of formwork and prior to any patching or repair work.

C. Owner's Testing Agency shall submit for record inspection, observation, and/or test reports to the Owner and Design Professionals, as required herein and shall provide an evaluation statement in each report stating whether or not concrete formwork conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.

D. Immediately notify the Contractor, Owner and Design Professionals of deficiencies.

1.10 QUALITY CONTROL BY CONTRACTOR

See Section 033000.

1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

See Section 033000.

1.12 PERMITS AND WARRANTY

A. Permits: See Section 033000.

B. Warranty: See Section 033000. Failures include but are not limited to the following:
   1. Discoloration of concrete scheduled to remain exposed to view.
   2. Damage of concrete finishes caused by forms.
   3. Damage of concrete caused by form stripping.
   4. Non-compliance with form finishes required for designated architectural finishes.
   5. Non-compatibility of form release agent with subsequent architectural finish materials applied to concrete surfaces.
   6. Excessive and/or noticeable bowing in placed concrete members caused by deflection of formwork during concrete placement.

PART 2 - PRODUCTS

2.1 FORMWORK REQUIREMENTS

A. General Requirements:
   1. Formwork shall meet construction safety regulations for the state where the project is located.
   2. Forms shall be removable without impact, shock or damage to concrete surfaces, the structure and adjacent materials.
   3. Forms shall be tight-fitting, designed and fabricated for required finishes and to withstand concrete weight and maintain tolerances as specified in ACI 117 for the following designations: (See architectural drawings for locations).

a) Class A – For surfaces prominently exposed to public view where appearance is of special importance and at underside of all concrete elevated framing.
b) Class B – Coarse-textured concrete-formed surfaces intended to receive plaster, stucco or wainscoting.
c) Class C – General Standard for permanently exposed surfaces where other finishes are not specified.
d) Class D - Minimum quality surface where roughness is not objectionable, usually applied where surfaces will be concealed.

4. Furnish forms in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings, using form materials with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.
5. Butt Joints: Shall be solid and complete with backup material to prevent leakage of cement paste.

B. Form Finishes for Exposed Surfaces:
1. Type: Straight, smooth, free of cement paste leaks at butt-joints, surface imperfections and other irregularities detrimental to appearance of finished concrete, fully coordinated with requirements for required finish material.
2. Form exposed areas of columns, beams, ledges, balcony fascias to achieve true alignment and level soffit of edge beams and concrete edges. All such areas must be sharp, straight and true to line and level. Edge beams and concrete canopies and ledges must have adequate shoring to prevent any visible amount of sag and sufficient bracing to prevent any lateral movement during construction.

2.2 FORM MATERIALS

A. General: Plywood, fiberglass, metal, metal-framed plywood faced, or other acceptable panel-type materials.
1. Provide materials with sufficient strength to prevent warping.

B. Plywood: Of species and grade suitable for intended use, sound undamaged sheets with clean true edges, minimum 5/8" (16mm) thick, complying with U.S. Product Standard PS-1.
1. Other Acceptable Sheet Materials: 14 gauge (2.0mm) sheet steel or fibrous glass reinforced resin.

C. Lumber: Construction grade or better consistent with calculation requirements, without loose knots or other defects.
1. Use only where entire width can be covered with one board 11-1/4" (285mm) or less in width.

D. Forms for Cylindrical Columns and Supports: Metal, glass-fiber reinforced plastic, or paper or fiber tubes that will produce smooth surfaces without joint indications.
1. Provide units with sufficient wall thickness to resist wet concrete loads without deformation.

E. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to support weight of placed concrete without deformation.

F. Chamfer for Form Corners:
1. Types: Chamfer strips of wood, metal, PVC or rubber fabricated to produce smooth form lines and tight edge joints, 3/4" (20mm) size, maximum possible lengths.
2. Required for all exposed corners of beam, walls and column forms.

G. Form Ties:
1. Type: Factory-fabricated metal, adjustable length, designed to prevent form deflection and to prevent spalling concrete upon removal.
2. Ties used for architecturally exposed concrete shall be galvanized.
3. Ties shall not leave metal closer than 1-1/2" (40mm) to exposed surface.
4. When removed, ties shall not leave holes larger than 1" (25mm) diameter in concrete surface.
5. Removable Ties: Use type with tapered cones, 1" (25mm) outside diameter, for concrete walls which will remain exposed to view and scheduled for architectural finishes.
6. Snap-Off Ties: Use for concrete walls below grade and walls which will not remain exposed to view and are not scheduled for architectural finishes.
7. Wire Ties: Not acceptable.

H. Nails, Spikes, Lag Bolts, Thru-Bolts, Anchorages:
1. Type: Of size, strength and quality to meet the required quality of formwork.

I. Form Release Agent:
1. Type: Commercial formulation form release agent of non-emulsifiable type which will not bond with, stain, or adversely affect concrete surfaces. Form release agent shall not impair subsequent treatment of concrete surfaces requiring bond or adhesion, or impede the wetting of surfaces to be cured with water or curing compounds. Form release agent shall be compatible with subsequent architectural finish materials applied to concrete surfaces. Apply in compliance with manufacturers' instructions.

2. Form release agent shall meet, at a minimum, all federal and state requirements for volatile organic compounds (VOC's).
3. For Steel Forms: Non-staining rust-preventative type.

J. Reglets: Provide sheet metal reglets formed of same type and gauge as flashing metal, unless indicated otherwise on Drawings. Where resilient or elastomeric sheet flashing, or bituminous membranes are terminated in reglets, provide reglets of not less than 26 gauge (0.55mm) galvanized sheet metal. Fill reglet or cover face opening to prevent intrusion of concrete or debris.

K. Coordinate with materials as specified in Section 032000/Concrete Reinforcement and Embedded Assemblies.

PART 3 - EXECUTION

3.1 FORMWORK

A. General:
1. Inspect areas to receive formwork.
   a) Immediately notify the Owner's Testing Agency and Design Professionals in writing of conditions that will adversely affect the Work.
2. Construct forms to sizes, shapes, lines, and dimensions shown on Contract Documents, and to obtain accurate alignment, location, grades, level and plumb work in finished structures.
3. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins, and to maintain alignment.
4. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, drips, bevels, chamfers, blocking, screeds, bulkheads, anchorages and inserts and other features required in the Work.
5. Comply with shop drawings, ACI 301, 318, 347 and Contract Documents.
6. Maintain formwork and finished work construction tolerances complying with ACI 301 and 117.
7. Provide shore and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof.
8. Erect forms for easy removal without hammering or prying against concrete surfaces.
9. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces.
10. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only.
11. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
12. Chamfer exposed corners and edges as indicated on the architectural drawings, using wood, metal, PVC or rubber chamfer strips fabricated to produce smooth lines and tight edge joints.
13. Design, erect, support, brace and maintain formwork and shoring to support loads until such loads can be safely supported by the concrete structure.
14. Where specifically shown on the Contract Documents as monolithic, upturned beams, curbs and similar members in connection with slabs shall be formed so that they can be poured integrally with slabs.

B. Concrete Accessories and Embedded Items:
1. Install into forms concrete accessories, sleeves, inserts, anchor bolts, anchorage devices and other miscellaneous embedded items furnished by other trades or that are required for other work that is attached to or supported by cast-in-place concrete.
   a) Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached.
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, relieving angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated on drawings or required by other trades.
4. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces.
5. Coordinate with CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES Section in Specification 032000.
6. Install accessories and embedded items straight, level, plumb and secure in place to prevent displacement by concrete placement.

C. Temporary Openings:
1. Locate temporary openings in forms at inconspicuous locations.

2. For clean-outs and inspection before concrete placement, locate temporary openings where interior area of formwork would otherwise be inaccessible.
3. For cleaning and inspections, locate openings at bottom of forms to allow flushing water to drain.
4. Securely brace temporary openings and set tightly in forms to prevent loss of concrete.
5. Close temporary openings with tight fitting panels, flush with inside face of forms, neatly fitted so that joints will not be noticeable on exposed concrete surfaces.

D. Provisions for Other Trades: Coordinate and provide openings in concrete formwork to accommodate work of other trades.
1. Determine size and location of openings, recesses, chases, offsets, openings, depressions, and curbs from information provided by trades requiring such items.
2. Accurately place and securely support items built into forms.

E. Cleaning:
1. Normal Conditions:
   a) Thoroughly clean forms and adjacent surfaces to receive concrete.
   b) Remove chips, wood, sawdust, dirt, standing water or other debris just before placing concrete.
   c) Flush with water or use compressed air to remove remaining foreign matter.
   d) Verify that water and debris can drain from forms through clean-out ports.
2. During Cold Weather:
   a) Remove ice and snow from within forms.
   b) Do not use de-icing salts.
   c) Do not use water to clean out completed forms, unless formwork and concrete construction will proceed within heated enclosure.
   d) Use compressed air or other means to remove foreign matter.

F. Form Release Agents
1. Before placing reinforcing steel and miscellaneous embedded items, coat contact surfaces of forms with an approved non-residual, low VOC form release agent in accordance with manufacturer's published instructions.
2. Do not allow release agent to accumulate in forms or come into contact with reinforcement or concrete against which fresh concrete will be placed.
   a) Coat steel forms with nonstaining, rust-preventative material.
3. Remove form release agent and residue from reinforcement or surfaces not requiring form coating.

G. Before Placing Concrete:
1. Inspect and check completed formwork, shoring and bracing to ensure that work is in accordance with formwork requirements of this section and Contract Documents, and that supports, fastenings, wedges, ties, and parts are secure.
   a) Make necessary corrections or adjustment to formwork to meet tolerance requirements.
2. Retighten forms and bracing before concrete placement to prevent mortar leaks and maintain proper alignment.
3. Notify Owner’s Testing Agency sufficiently in advance of placement of concrete to allow inspection of completed and cleaned forms.

H. During Concrete Placement:
1. Maintain a check on formwork to ensure that forms, shoring, ties and other parts of formwork have not been disturbed by concrete placement methods or equipment.
2. Use positive means of adjustment as required for formwork settlement during concrete placing operations.

I. Camber:
1. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads.
2. Camber bottom forms where indicated on the drawings. Whenever forms are cambered, screeded levels for establishing top of concrete must be cambered to the same amount and to the same profiles such that scheduled depth of member is not reduced by lifting of forms. Check camber and adjust forms before initial set as required to maintain camber.

J. Surface Defects:
1. Install forms that will not impair the texture of the concrete and are compatible with the specified finish type.

K. Formwork Loads on Grade
1. Where loads from formwork bear on grade, provide suitable load-spreading devices for adequate support and to minimize settlement. In no event shall frozen ground or soft ground be utilized directly as the supporting medium.

L. Footings and Grade Beams:

1. Provide forms for footings and grade beams if soil or other conditions are such that earth trench forms are unsuitable.
2. When trench forms are used, provide an additional 1" (25mm) of concrete on each side of the minimum design profiles and dimensions indicated.
3. Earth forming of concrete elements is not acceptable.

M. For slabs-on-grade, secure edge forms in such a manner as to not move under weight of construction loads, construction and finishing equipment, or workers.

3.2 SHORES AND RESHORES

A. Comply with ACI 347.2R for shoring and reshoring in multistory construction, and as specified herein.
1. For non-post tensioned flat plate concrete structures of five supported levels or more, extend shoring/reshoring at least four levels below the floor or roof being placed (shore formwork, reshore three levels below)
2. For non-post tensioned flat plate concrete structures of less than five supported levels, extend shoring/reshoring to ground.
3. For all other concrete structures of four supported levels or more, extend shoring/reshoring at least three levels below the floor or roof being placed (shore formwork, reshore two levels below)
4. For all other concrete structures of less than four supported levels, extend shoring/reshoring to ground.
5. For shoring/reshoring placed on mud sills, adjustments shall be made by contractor to account for ground settlement.
6. Locate shores/reshores such that the factored (ultimate) construction load imposed onto any slab or beam at any time during the construction cycle does not exceed 90% of the factored (ultimate) design load for that slab or beam, scaled down to reflect effect on capacity of lower concrete strength at time of loading.
7. Construction load shall include the weight of wet concrete, total weight of formwork and shoring/reshoring, and a minimum construction live load of 50 psf (2.5kPa) (increase if construction operations will produce higher loading). Design load includes self-weight of the slab, and superimposed dead and live loads as indicated on the drawings.
8. For comparison of construction loads to design loads, compare factored (ultimate) construction loads to factored (ultimate) design loads. For construction dead and live loads, use the same load factors and load combinations as required by ACI 318 for design dead and live loads. The specified strength reduction factors from ACI 318 should also be applied during the strength evaluation of the partially completed structure.
9. For flat plate or flat slab construction "backshores" or "preshores" as defined in ACI 347 shall be permitted only if appropriate calculations and construction sequences are provided demonstrating that the accumulation of shore loads will not overload any slab. In the absence of such calculations and construction sequences, shores must be removed and reshores installed in a sequence such that each floor is permitted to deflect and carry its own weight prior to the installation of reshores.
10. Reshores shall not be removed until the concrete has attained its specified 28 day strength.

3.3 REMOVING FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10°C) for 12 hours after placing concrete, provided concrete is sufficiently hard to avoid damage by form-removal operations, and provided curing and protection operations are maintained after removal of formwork.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed until concrete has attained at least 75% of design compressive strength as proven by cylinder test. If stripping occurs before 3 days, 100% strength must be achieved.
1. Provide reshores as required per ACI 347.
2. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Remove formwork progressively using methods to prevent shock loads or unbalanced loads from being imposed on structure. Comply with ACI 347.

D. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against concrete surfaces.

E. Reshore structural members where required due to design requirements, construction requirements, or construction conditions.
1. Reshore on same day shoring and forms are removed.

F. Whenever formwork is removed during the curing period, the exposed concrete shall be cured per requirements of Section 033000.

G. All wood formwork, including that used in void spaces, pockets and other similar places shall be removed.

H. Form tie holes shall be filled as per approved samples submitted to the Design Professionals.
I. The Contractor shall assume responsibility for all damage due to removal of the forms.

3.4 RE-USING FORMS

A. Before forms can be re-used, surfaces that will be in contact with freshly poured concrete must be thoroughly cleaned, damaged areas repaired, and projecting nails withdrawn.
   1. Split, frayed, delaminated or otherwise damaged form-facing material will not be acceptable.
   2. Apply new form release agent on re-used forms.
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.
C. Forms for exposed concrete may be reused only if the surfaces have not absorbed moisture and have not splintered, warped, discolored, stained, rusted or peeled, subject to acceptance by the Design Professionals. The Design Professionals reserve the right to require the Contractor to remove and reconstruct such formwork as will produce subsequent areas that are acceptable. Do not use "patched" forms for exposed concrete surfaces, unless approved by the Design Professionals.

3.5 CORRECTIVE MEASURES

A. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION 031000

SECTION 032000 - CONCRETE REINFORCEMENT AND EMBEDDED ASSEMBLIES

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation for reinforcing steel, accessories, embedments and miscellaneous anchorage accessories, joint fillers, and waterstops for cast-in-place concrete work as shown on Drawings, as specified herein, and as required by the job conditions.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Concrete Formwork	Section 031000
Cast-in-Place Concrete	Section 033000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 301 –Specifications for Structural Concrete.
3. ACI 315 – Details and Detailing of Concrete Reinforcement.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. ACI 355.2 – Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
6. ACI 355.4 – Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary
7. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
8. AWS D1.1 – Structural Welding Code-Steel.
9. AWS D1.4 – Structural Welding Code-Reinforcing Steel.
10. CRD C 572 – Specification for Polyvinylchloride Waterstops.
11. Concrete Reinforcing Steel Institute "Manual of Standard Practice"
12. ASTM D3963 Fabrication and Jobsite Handling of epoxy Coated Steel Reinforcing Bars.

C. Definitions:

1. See Section 033000.

1.5 CONTRACTOR QUALIFICATIONS

A. The work of this section shall be performed by a fabricator specializing in the type of reinforcement fabrication required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.

1. Welders shall be qualified in accordance with applicable AWS Code within 12 months before starting the work.
   a) Make qualification records available to the Design Professionals upon request.

B. Manufacturers shall specialize in manufacturing the types of concrete accessories required for cast-in-place concrete work, with a minimum of 10 years of documented successful experience and shall have the facilities capable of meeting all requirements of Contract Documents as a single-source responsibility and warranty for each type of accessory.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.

(1) Submittal Schedule
(2) Shop Drawings
(3) Product Data

(4) Mill Reports
(5) Reinforcement Strain Test
(6) Hazardous Materials Notification

1. Submittal Schedule: See Section 033000.
2. Shop Drawings: Submit for action shop drawings that shall clearly indicate, but not be limited to:
   a) All details, dimensions and information required for fabrication and placement of concrete reinforcement in accordance with Contract Documents, prepared in accordance with ACI 315 recommendations.
   b) Elevations, plans, sections, and dimensions of concrete work with required reinforcement clearances.
   c) Ledges, brackets, openings, sleeves, anchor rods, embedments, prefabricated bent-in dowel keyway systems, electrical conduit and items of other trades including interference with reinforcing materials.
   d) Sizes, grade designations, spacing, locations, and quantities of wire fabric, reinforcement bars, temperature and shrinkage reinforcement dowels.
      i. Do not use dimensions scaled from Contract Drawings to determine bar lengths.
      ii. Hooks and bends not specifically dimensioned shall be detailed per ACI 318.
   e) Bending and cutting schedules, assembly diagrams, splicing and connection requirements, details, and laps.
   f) Each type of supporting and spacing devices, including miscellaneous accessories.
   g) Construction joint type, details, and locations. Contractor shall coordinate construction joint type, details, and locations with concrete pour schedule. Submittal shall include details for each type of construction joint in accordance with Contract Documents.
   h) Locations and dimensions of openings in structural members including floor slab, shear walls, columns and beams. See SUBMITTALS Section of Specification 033000.
   i) Concrete accessories and embedded items. See SUBMITTALS Section of Specification 033000.
3. Product Data: Submit for action for each type of product identified in Part 2. Product Data shall be clearly marked to indicate all technical information which specifies full compliance with this section and Contract Documents, including published installation instructions and I.C.C reports, where applicable, for products of each manufacturer specified in this section.
4. Mill Reports: Submit for record.
5. Reinforcement Strain Test: For Grade 75 reinforcement, submit for record certification that steel has a yield strength of no less than 75 ksi as measured by both ASTM A615 and ACI 318 Section 3.5.3.2 procedures.
6. Hazardous Materials Notification: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

B. Submittal Process: See Section 033000
C. SER Submittal Review: See Section 033000
D. Substitution Request: See Section 033000
E. Request for Information (RFI): See Section 033000

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with General Conditions and Division 1, including the following:
1. Deliver reinforcing steel to Project site bundled, tagged and marked.
   a) Use weatherproof tags indicating bar sizes, lengths and other information corresponding to markings shown on placement diagrams.
2. Deliver welded wire fabric in sheets. Do not deliver in rolls.
3. During construction period, properly store reinforcing steel and accessories to assure uniformity throughout the Project.
4. Deliver and store welding electrodes in accordance with AWS D1.4.
5. Immediately remove from site materials not complying with Contract Documents or determined to be damaged.
6. Store reinforcing steel above ground so that it remains clean.
   a) Maintain steel surfaces free from materials and coatings that might impair bond.
   b) Keep covered.
   c) Protect against corrosion or deterioration of any kind.

1.8 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. Field Quality Assurance General: The Owner's Testing Agency shall test and inspect concrete reinforcement and embedded assemblies as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the Design Professionals for final acceptance.

B. Owner's Testing Agency shall provide qualified personnel at the site to inspect reinforcement, embedments, and accessories using the latest Drawings and reviewed shop drawings, as follows:
   1. Prior to placement, inspect reinforcement and embeds for grade, quality of material, absence of foreign matter, and for suitable storage.
   2. Provide continuous inspection of reinforcement and embedded assemblies during placement and immediately prior to concreting operations for: size, quantity, vertical and horizontal spacing and location, correctness of bends and splices, mechanical splices, clearances, compliance with specified tolerances, security of supports and ties, concrete cover, and absence of foreign matter.
   3. Inspect epoxy-coated reinforcement for coating damage and required applied coatings.
   4. Provide continuous inspection of adhesive anchors installed in horizontal or upwardly inclined orientations and those marked (CERT) on the latest Drawings.

C. Adhesive anchors shall be proof tested in tension as follows:
   1. The Owner's Testing Agency shall submit an adhesive anchorage proof testing plan to the SER for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.
   2. Proof testing shall be performed as a confined tension test in accordance with the guidelines of ASTM E488 and the requirements of ACI 355.4.
   3. Testing shall be performed after the minimum curing period specified by the manufacturer.
   4. 5 percent of each type and size of an adhesive anchor assembly and 100 percent of anchors marked (CERT) shall be proof tested in tension by the Owner's Testing Agency.
   5. All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the SER prior to performance of the testing.
   6. The adhesive anchors proof tension loads shall be as specified in the general notes of the structural drawings.
   7. Anchors shall have no visible indications of displacement or damage during or after proof load application. Concrete cracking in the vicinity of the anchor after loading shall be considered a failure.
   8. If more than 10% of the tested adhesive anchors fail to achieve the specified proof load, 100% of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the SER. Immediately notify the SER of all failed proof tests.

D. Mechanical post-installed anchors shall be proof tested as follows:
   1. The Owner's Testing Agency shall submit a mechanical anchorage proof testing plan to the SER for review and approval prior to performing the anchor proof testing. The anchorage testing plan shall meet the requirements as specified in this section and indicate which anchors have been selected for testing.
   2. 5 percent of each type and size of mechanical anchor shall be proof tested by the Owner's Testing Agency. The required proof test for the anchors is as follows:
      a) For torque-controlled mechanical anchors, a proof torque shall be applied to the anchor using a calibrated torque wrench and the proof torque shall be achieved with no more than one-half turn of the anchor nut.
      b) For displacement-controlled mechanical anchors, proof of set is to be achieved by inserting the proper setting tool into the anchor and verifying that full set has been achieved.
   3. The required proof torque load for torque-controlled mechanical anchors shall be as specified in the general notes of the structural drawings.
   4. All anchors selected for proof testing shall be production anchors. Sacrificial anchors are not acceptable for inclusion in the proof testing plan unless specifically approved by the SER prior to performance of the testing.
   5. Concrete cracking in the vicinity of the anchor during or after proof torque load application shall be considered a failure.
   6. If more than 10% of the tested mechanical anchors fail to achieve the specified proof torque load or set, 100% of the anchors of the same diameter and type as the failed anchor shall be proof tested, unless otherwise direct in writing by the SER. Immediately notify the SER of all failed proof tests.

E. Periodic inspection for post-installed adhesive and mechanical anchors shall be provided in accordance with the building code except that continuous inspection shall be provided for the conditions identified in

section B.4. The inspector shall observe all aspects of the anchor installation and shall, at a minimum, verify the following items:

1. Hole drilling method in accordance with the Manufacturer's Published Installation Instructions (MPII) and these installation requirements.
2. Anchor spacing and edge distance.
3. Hole diameter and depth.
4. Hole cleaning in accordance with the MPII.
5. Anchor element type, material, diameter, and length.
6. For adhesive anchors, adhesive identification and expiration date.
7. For adhesive anchors, adhesive installation in accordance with the MPII.
8. For torque-controlled mechanical anchors, the number of turns required to achieve the anchor set torque per the MPII.
9. For displacement-controlled mechanical anchors, the proper setting tool is used to achieve the anchor set per the MPII.

F. Owner's Testing Agency shall submit for record inspection, observation, and/or test reports to the Owner and Design Professionals, as required herein and shall provide an evaluation statement in each report stating whether or not concrete reinforcement, embedded assemblies, and post-installed anchors conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.

G. Immediately notify the Contractor, Owner and Design Professionals of deficiencies.

1.9 QUALITY CONTROL BY CONTRACTOR
See Section 033000.

1.10 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS
See Section 033000.

1.11 PERMITS AND WARRANTY

A. Permits: See Section 033000.

B. Warranty: See Section 033000. Failures include but are not limited to the following:

1. Bars with kinks or bends not indicated on Drawings or on approved shop drawings.
2. Bars damaged due to bending, straightening or cutting.
3. Bars heated for bending.

PART 2 - PRODUCTS

2.1 REINFORCEMENT

A. Reinforcing Steel:

1. Type: Deformed billet steel bars, ASTM A 615, Grade 60 or 75 as indicated on Drawings.
2. Size: As indicated on structural Drawings.
3. Where indicated on Drawings, reinforcing steel shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.
   a) Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.
4. Epoxy-Coated: ASTM A 775 where indicated on Drawings.
5. Weldable reinforcement: ASTM A 706 where indicated on Drawings.

B. Welded Wire Reinforcement:

1. Type: steel wire, deformed, ASTM A 496.
2. Size: As indicated on structural Drawings.
3. Where indicated on Drawings, welded wire reinforcement shall be hot-dipped galvanized after fabrication in accordance with ASTM A 767, Class II, with galvanizing material protected from embrittlement during galvanizing process in accordance with ASTM A 143.
   a) Galvanized finish shall meet the bend and shear test requirements of ASTM A 615.
4. Plain Steel Welded Wire Reinforcement: ASTM A 1064.
5. Deformed Steel Welded Wire Reinforcement: ASTM A 497.
6. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884, Class A.

C. Shear Reinforcement At Slab-Column Connections:

1. Type: Steel studrail assemblies for shear reinforcement at slab-column connections shall be DECON STUDRAILS supplied by DECON USA, Medford New Jersey.
   a) Shear studs shall be in accordance with ASTM A108, Grade C1015.
   b) Rails shall be low carbon steel Type 44W.
   c) Studs shall be welded in accordance with AWS D1.1.

2. Size: As indicated on structural Drawings.
3. Installation: Per manufacturer's instructions.
4. Supports: Use plastic molded plastic chairs as provided by the manufacturer to maintain the bottom rebar cover as specified on the Drawings. Tie studrails to adjacent top bars to maintain vertical position.

D. Reinforcement Coating Repair Materials:
1. Apply repair coating in accordance with the manufacturer's written procedures.
2. Galvanized Repair Coating: Zinc-based solder, paint containing zinc dust or sprayed zinc complying with ASTM A780.
3. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/ A 775M.
a) The maximum amount of repaired damaged areas shall not exceed 2% of the surface area in each linear foot of each bar. If more than 2% of the surface area in each linear foot of bar is damaged, bar shall be replaced.

2.2 ACCESSORIES
A. Tie Wire:
1. Type: Minimum 16 gauge (1.5mm) annealed steel wire, ASTM A 510 and ASTM A 853.
2. Wire Bar Type: Comply with CRSI.

B. Mechanical Splicing Systems:
1. Mechanical tension and compression splicing systems shall be used where indicated on Drawings or at contractor's option. For seismic design categories D, E and F, in plastic hinge regions, only Type 2 mechanical splices are permitted.
2. Acceptable Products: Bartec Couplers by Dextra, Santa Fe Springs, CA or Lenton Cadweld by Erico, Solon, OH or Bar Lock coupler system by Dayton Superior, Miamisburg, OH or Grip-Twist by Bar Splice, Dayton, OH or ZAP Screwlok by Bar Splice, Dayton, OH or Lenton Couplers by Erico, Solon, OH. Splices shall be installed in compliance with manufacturer's requirements.
3. Mechanical and welded tensile mechanical splicing systems shall be capable of developing 125% of the reinforcing steel ASTM specified minimum yield strength (Type 1) except where indicated as Type 2 (100% of specified tensile strength).
4. Mechanical compression splices shall be such that the compression stress is transmitted by end bearing held in concentric contact.

C. Headed Bars:
1. For bar sizes #11 (ø36) or smaller where specifically detailed on Drawings, mechanical bar terminators shall be used.
2. Acceptable Products: Bartec End Anchors by Dextra, Santa Fe Springs, CA or Lenton Terminator by Erico, Solon, OH or Grip-Twist Doughnut by Bar-Splice, Dayton, OH or Bar Lock End Anchorage System by Dayton Superior, Miamisburg, OH.

D. Supports for Reinforcement:
1. Types: Bolsters, chairs, spacers, clips, chair bars, and other devices for properly placing, spacing, supporting, and fastening the reinforcement, plastic, plastic protected steel, or epoxy coated to match supported reinforcement.
2. For Contact with Forms: Use types with not less than 3/32" (2.5mm) of plastic between metal and concrete surface.
a) Plastic tips shall extend not less than ½" (12mm) on metal legs.
3. Individual and continuous slab bolsters and chairs shall be of type to suit various conditions encountered and must be capable of supporting 300 pound (1.5kN) load without damage or permanent distortion.
4. Unless otherwise indicated on Drawings, bottom reinforcing bars in footings shall be supported by precast concrete bricks or individual high chairs with welded sand plates on bottom.
5. For Slabs on Grade: Use supports with sand plates or horizontal runners where base material will not support chair legs.

E. Deformed Bar Anchors:
1. Type: Automatic end welded, ASTM A 496 quality.
2. Size and Grade: As indicated on structural Drawings by Nelson Stud Welding.

F. Anchor rods and dowels:
1. Types and Sizes: Provide sizes and types of anchor rods and dowels as indicated on the Drawings. Each type of anchor shall be manufactured of structural quality steel, designed for cast-in-place concrete applications and be of sizes as indicated on Drawings, complete with washers, nuts, plates and miscellaneous accessories required to meet Contract Document requirements.
2. Adhesive Anchors for anchor rods and dowels in existing concrete: See Anchorage Accessories.

G. Prefabricated Bent-In Dowel Keyway System:

1. Type, Size and Grade as indicated on Drawings.
2. Acceptable Products: Lenton Form Savers by Erico, Solon, OH or Stabox by Meadow Burke, Tampa, FL or Metalstrip by Dayton Superior, Miamisburg, OH.
3. Installation: Per Manufacturer's instructions.

2.3 ANCHORAGE ACCESSORIES

A. General: Miscellaneous anchorage accessories for anchoring structural, architectural, electrical, and mechanical items to poured concrete shall include but not be limited to the following:
   1. Concrete Anchors: Headed or bent studs ASTM A 108/Grade 1015 through 1020, minimum yield strength of 50,000 psi (345MPa), minimum tensile strength of 60,000 psi (415MPa).
   2. Anchor Rods: ASTM F1554, Grade as noted on Drawings.
   3. Threaded Inserts: Manufactured by Dayton/Richmond Screw Anchor Co. or Powers Fasteners, Inc.
   4. Adhesive Anchors:
      a) Basis of Design: See General Notes
      b) Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure
         i. HIT-RE 500-SD by Hilti, Inc., Tulsa, OK
         ii. Epcon C6+ by ITW Red Head, Glendale Heights, IL
         iii. Epcon G5 by ITW Red Head, Glendale Heights, IL
         iv. PE 1000+ by Powers Fasteners, Brewster, NY
         v. Pure 110+ by Powers Fasteners, Brewster, NY
         vi. SET-XP by Simpson Strong-Tie Co., Pleasanton, CA
      c) The adhesive anchor system used for post-installed anchorage to concrete shall conform to the requirements of ACI 355.4 and commentary and shall possess a current ICC- ES report demonstrating compliance with ACI 318.
   5. Expansion Anchors:
      a) Basis of Design: See General Notes
      b) Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure.
         i. Power Stud+ SD1 or SD2 by Powers Fasteners, Brewster, NY
         ii. Power Stud + SD6 (SS) by Powers Fasteners, Brewster, NY
         iii. Trubolt or Trubolt+ by ITW Red Head, Glendale Heights, IL
         iv. Strong-Bolt by Simpson Strong-Tie Co., Pleasanton, CA
      c) The expansion anchors used for post-installed anchorage to concrete shall conform to the requirements of ACI 355.2 and commentary and shall possess a current ICC- ES report demonstrating compliance with ACI 318.
   6. Threaded Screw Anchors:
      a) Basis of Design: See General Notes
      b) Substitution Request: As anchor capacities vary by manufacturer, the following anchors will be considered as a Substitution Request. Refer to project specifications for Substitution Request procedure.
         i. Wedge Bolt+ by Powers Fasteners, Brewster, NY
         ii. Tapcon by ITW Red Head, Glendale Heights, IL
         iii. Titan HD by Simpson Strong-Tie Co., Pleasanton, CA
   7. Inserts and Coil Rods: Yield strength 65,000 psi (450MPa), ASTM B 633, manufactured by Acrow-Richmond Limited or Dayton Superior, Dayton, OH.
   8. Welding Electrodes: AWS 5.5, Series E70.
   9. Welded Deformed Bar Anchors: Welded by full-fusion process, as furnished by TRW Nelson Stud Welding Division or equivalent.

B. Dovetail Anchor Slots:
   1. Type: Formed 22 gauge (0.85mm) galvanized steel manufactured by Heckmann Building Products, Chicago, Illinois or Hohmann and Barnard, Hauppauge, New York or Pro-Slot by BoMetals, Inc., Carrollton, GA.
   2. Location of Use: Continuous installation of anchor slots, full height of masonry walls, where masonry walls abut poured concrete walls.
   3. Fill slot with temporary filler or cover face opening to prevent intrusion of concrete or debris.
   4. Finish: Hot-dip galvanized or zinc-plated steel.
   5. Stainless steel anchors are acceptable.

2.4 JOINT FILLERS

A. Permanent Compressible Joint Filler:
1. Type: W. R. Meadows: “Ceramar” closed-cell expansion joint filler, ultraviolet stable, minimal moisture absorption, non-impregnated, nonstaining and nonbleeding, inert and compatible with cold-applied sealants.
2. Location of Use: Slabs and curbs as indicated on Drawings or required.
3. Thickness: As indicated on Drawings or required.

B. Temporary Compressible Joint Filler:
1. Type: White molded polystyrene beadboard.
2. Location of Use:
a) In slabs, curbs, and walls which must be removed prior to joint sealant installation.
b) Vertically to isolate walls from columns or other walls.

C. Semi Rigid Joint Filler:
1. Acceptable Product: Euclid Chemical Company “Euco 700” or “Euco QWIKjoint 200”
2. Acceptable Product: Sika Corporation “Sikadur 51 SL”
3. Acceptable Product: W.R. Meadows Sealtight “Rezi-Weld Flex”

D. Noncompressible Joint Filler:
1. Type: Dow Chemical's "STYROFOAM 40" rigid closed-cell extruded polystyrene board, square edges, 40 psi (275kPa) compressive strength, ASTM C 578, Type IV.
2. Thickness: As indicated on Drawings.
3. Location of Use: As indicated on Drawings or required.

E. Asphalt-Impregnated Joint Filler:
1. Type: W.R. Meadows Asphalt Expansion Joint Filler, preformed, ASTM D 994.
2. Thickness: ½” (12mm) maximum, as indicated on Drawings or required.
3. Location of Use: Sidewalks at foundation walls and as indicated on Drawings or required.

F. Asphalt-impregnated fiberboard expansion joint filler for interior work:
1. Type: ASTM D1751.

G. Self-expanding cork board expansion joint filler for exterior work:
1. Type: ASTM D1752.

H. Construction Joints:
1. Type: Tongue and groove type profile of galvanized steel, with knock-out holes at 6" (150mm) on center to receive dowelling, complete with anchorage.

2.5 WATERSTOPS

A. Preformed Swellable Waterproofing Strips especially formulated for concrete cold joints at footings, walls, or slabs.
1. Acceptable Products:
a) “Volclay Waterstop RX” by CETCO Building Materials Group, Hoffman Estates, IL
b) “Adcor ES” by W. R. Grace & Co., Cambridge, MA
c) “Hydrotite” by Sika, Lyndhurst, NJ
2. Size: 3/4" (20mm) by 3/8" (10mm) strips minimum, 25 ft. (7.5m) long, and weighing at least 0.165 lbs/ft (0.245kg/m).
3. Location of Use: Concrete cold joints at footings, walls and slab joints.
4. Comply with manufacturer product application and installation instructions.

B. Polyvinyl Chloride Waterstops:
1. Type: PVC Waterstops for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections and directional changes. U.S. Corp of Engineers Specification CRD C 572.
2. Acceptable Products:
a) “PVC Waterstops” by BoMetals, Carrollton, GA
b) “Greenstreak” by Sika, Lyndhurst, NJ
c) “Sealtight PVC Waterstops” by W.R. Meadows, Hampshire, IL

PART 3 - EXECUTION

3.1 FABRICATION

A. Reinforcing Steel Fabrication:
1. Fabricate in accordance with approved shop Drawings, ACI 315 and Contract Documents.
2. Heating of Reinforcement: Will be permitted only with specific prior approval of the SER.
3. Welding: Comply with ANSI/AWS D1.4; use E9018 electrodes or approved electrodes.
4. Tolerances: Comply with ACI 117.
5. Unacceptable Materials: Reinforcement with any of following defects will not be permitted in Work.

a) Bar lengths, depths, and bends exceeding ACI fabrication tolerances.
b) Bends or kinks not indicated on Drawings or final shop drawings.
c) Bars with reduced cross-section due to excessive rusting or other cause.

B. Welded Wire Reinforcement:
1. Type: As fabricated in accordance with CRSI, unless otherwise noted.

C. Templates:
1. Required for all footing and column dowels, and where required for proper alignment of reinforcing.

D. Assemblies:
1. Fabricate and assemble structural steel items in shop in conformance with AISC and AWS D1.1. Shearing, flame cutting, and chipping shall be done carefully and accurately. Cut, drill, or punch holes at right angles to the surface of the metal. Do not make or enlarge holes by burning. Holes shall be clean-cut without torn or ragged edges.
2. Welding of deformed bar anchors and headed stud anchors shall be installed by full-fusion process equivalent to TRW Nelson Stud Welding Division or KSM Welding Services Division, Omark Industries or Tru-Weld Stud Welding, Medina, OH.
3. Welding of reinforcement shall be done in accordance with AWS requirements. Welding shall be performed subject to the observance and testing by Owner's Testing Agency.
4. Galvanizing where required, shall be applied after fabrication and prior to casting concrete.
5. Welding of crossing bars (tack welding) for assembly of reinforcement is not permitted without use of weldable reinforcement and express written consent of SER.

3.2 INSTALLATION OF REINFORCEMENT

A. General:
1. Perform the work of this section in accordance with approved shop drawings, ACI 318 and CRSI recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as specified.
2. Before placing reinforcement steel, inspect forms for proper fitting and compliance with allowable tolerances.
3. Reinforcement shall be free of form coatings, sealers, powdered and scaled rust, loose mill scale, earth, ice, and other materials which will reduce or destroy bond with concrete.
4. Do not place concrete until the completed reinforcement steel work has been observed and accepted by Owner's Testing Laboratory.
5. Reinforcement steel is not permitted to be "floated into position".
6. Bend bars cold.
a) Do not heat or flame cut bars.
b) No field bending of bars partially embedded in concrete is permitted, unless specifically approved by the SER and tested by Independent Testing Agency for cracks.
7. Weld only as indicated.
a) Perform welding per ANSI/AWS D12.1 and/or ANSI/AWS D1.4.
b) See structural Drawings for additional requirements.
8. Tag reinforcement steel for easy identification.

B. Placement of Reinforcement Bars:
1. Comply with approved shop drawings, ACI 318 and Contract Documents.
2. Accurately position, support and secure reinforcement in a manner to prevent displacement before and during placement of concrete.
a) Place reinforcement bars within tolerances specified in ACI 117.
b) Locate and support reinforcement by metal chairs, runners, bolsters, spacers, hangers and other accessories for fastening reinforcing bars and welded wire reinforcement in place.
3. If bars are displaced beyond specified tolerance when relocating the bars to avoid interference with other reinforcement or embedded items, immediately notify the Design Professionals for approval prior to concrete placement.
4. Avoid cutting or puncturing vapor retarder during reinforcement placement.
a) Repair damages before placing concrete.
5. Concrete Coverage: Maintain concrete cover around reinforcement as indicated on Drawings.
6. Bar Supports: Use type specified in this section.
7. Tie Wires: After cutting, turn tie wires to the inside of section and bend so that concrete placement will not force ends to be exposed at face of concrete.

C. Placement of Wire Reinforcement:
1. Install in lengths as long as practicable.
2. Support in position adequately to prevent bending of reinforcement between supports before and during placement of concrete.
3. Overlap the wire reinforcement 6" (150mm) or one panel width + 2" (50mm), whichever is larger.

a) Securely tie together with wire.

4. Offset laps of adjoining widths to prevent continuous laps in either direction.
5. Locate wire fabric in the top third of slabs, unless noted otherwise on structural Drawings.

D. At Construction Joints:
1. Reinforcement bars and wire reinforcement shall be continuous through construction joints, unless otherwise indicated on Drawings. See Drawings for scheduled lap splices.

E. At Expansion Joints:
1. Reinforcing bars and wire fabric shall NOT be continuous through expansion joints, unless otherwise indicated on Drawings.

F. Splicing:
1. Unless otherwise indicated on Drawings provide lap splices for bar sizes #11 (ø36) and smaller by lapping ends, placing bars in contact, and tying tightly with wire in accordance with requirements of ACI 318 for lap lengths indicated on Drawings.
2. At all #14 (ø43) and #18 (ø57) bars and where mechanical splices are specifically indicated on Drawings, comply with requirements specified in this Specification section under “Mechanical Splicing Systems”.
3. Do not splice reinforcement except as indicated on structural Drawings.
4. Tension couplers may be used and installed per manufacturer’s specifications where indicated on Drawings or as approved by Engineer.

G. Dowels in Existing Concrete:
1. Install dowels and dowel adhesive in accordance with supplier’s recommendations.
2. Minimum embedment length shall be 12 bar diameters, unless noted otherwise.

3.3 INSTALLATION OF POST-INSTALLED ADHESIVE ANCHORS

A. General:
1. Post-installed adhesive anchors shall be installed in accordance with the Manufacturer’s Printed Installation Instructions (MPII).
2. The adhesive anchors shall be supplied as an entire system. The contractor shall provide all equipment required to install the adhesive anchor in accordance with the MPII.
3. Anchors shall be installed in holes drilled with a rotary impact hammer drill with carbide bit. Contractor shall obtain prior written approval from SER before using rock drilling or core drilling installation methods.
4. Anchor holes shall be thoroughly cleaned and dry prior to adhesive injection, in accordance with the MPII. Anchors to be installed in the adhesive shall be clean, oil-free, and free of loose rust, paint, or other coatings.
5. Concrete shall have a minimum compressive strength of 2500 psi (17MPa).
6. Concrete at time of adhesive anchor installation shall have a minimum of 21 days.
7. Concrete temperature at the time of adhesive anchor installation shall be at least equal to manufacture's requirements, or 50° F (10°C) if no requirement exists.
8. Support the anchor and protect it from disturbance or loading for the full cure time stated by the manufacturer at that base material temperature.
9. Unless specified otherwise in the contract documents, anchors shall be installed perpendicular to the concrete surface. Anchors displaced or disturbed prior to the adhesive cure time shall be considered damaged and reported to the SER (see Observations and Corrections section of 033000).
10. Locate, by non-destructive means, and avoid all existing reinforcement prior to installation of anchors. If existing reinforcement layout prohibits the installation of anchors as indicated in the drawings the contractor shall immediately notify the Design Professionals.
11. Reinforcement bars or all-threaded bars shall not be bent after being adhesively embedded in hardened, sound concrete, unless written approval is given by the SER.
12. All personnel installing anchors shall be trained by the manufacturer on proper installation techniques. Submit for record certificate from training documentation from the manufacturer for each installer on this Project
13. Installation of adhesive anchors horizontally or upwardly inclined and anchors that are designated with a (CERT) after the anchor call-out, shall be performed by personnel certified by the ACI/CRSI Adhesive Anchor Installer Certification program. Submit for record certificate from ACI-CRSI Adhesive Anchor Installation Certification Program for each certified installer on this Project.

3.4 INSTALLATION OF ACCESSORIES AND EMBEDDED ITEMS

A. Install concrete accessories in accordance with manufacturer's published instructions and Contract Documents.

1. Set and secure embedments, including embedded plates, bearing plates, and anchor rods, per approved setting drawings and in such a manner to prevent movement during placement of concrete and to allow removal of formwork without damage.
2. Tolerances: Anchor rod and other embedded items placement tolerances shall comply with AISC 303, “Code of Standard Practice”, Section 7.5.
3. Inspect locations to receive concrete accessories.
4. Immediately notify the Design Professionals in writing of conditions that will adversely affect the Work or fail to meet Contract Document requirements.
5. Do not place concrete until reinforcement, accessories and other built-in items have been inspected and accepted by Owner’s Testing Agency.

B. Construction and Contraction (Control) Joints:
1. Construction and contraction (control) joints indicated on Drawings are mandatory and must not be omitted.
   a) Provide construction joints in accordance with ACI 318.
   b) Roughen surface at construction joints as indicated on the drawings.
   c) Where specifically indicated on drawings, provide 1-1/2” (40mm) deep key type construction joints at end of each placement for slabs, beams, walls and footings.
      i. Bevel forms for easy removal.
2. Provide waterstops in construction joints as indicated on the Contract Documents in sizes to suit joint.
3. Install waterstops to form continuous diaphragm in each joint.
4. Support and protect exposed waterstops during progress of Work.
5. Field-fabricate joints in waterstops according to manufacturer’s printed instructions.

C. Coordinate the installation of pipes, bolts, hangers, anchors, flashing and other embedded items with the work of other trades.

3.5 CORRECTIVE MEASURES

A. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 033000.

END OF SECTION 032000

SECTION 033000 – CAST-IN-PLACE CONCRETE – SITE STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Footings and pedestals.
2. Rain garden weirs.
3. Water feature structures.
4. Board form sign.
5. Concrete benches.

1.3 SUBMITTALS

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

B. Design Mixtures: For each concrete mixture, submit proposed mix designs sealed by a professional engineer registered in the state of Texas, in accordance with ACI 318. Each proposed mix design shall be accompanied by a record of past performance.
1. Submit alternate design mixtures when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

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

D. Qualification Data: For Installer, manufacturer and testing agency.

E. Material Test Reports: From a qualified testing agency, indicating and interpreting test results for compliance with requirements:

1. Aggregates.

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

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Waterstops.
6. Bonding agents.
7. Adhesives.
8. Joint-filler strips.
9. Repair materials.

G. Submit manufacturer's certification of maximum chloride ion content in admixtures.

H. Fly ash: Submit certification attesting to carbon content and compliance with ASTM C618.

J. Field quality-control test and inspection reports.

K. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: Unless otherwise noted, the contractor shall supply an independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field-Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

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

1. ACI 301, "Specification for Structural Concrete,"
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

G. 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.

2. Review testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.

1.5 DELIVERY, STORAGE, AND HANDLING

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

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

C. Store all proprietary materials in accordance with manufacturer’s recommendations.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

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

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

   a. High-density overlay, Class 1 or better.
   b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
   c. Structural 1, B-B or better; mill oiled and edge sealed.

d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

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

C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 1/2 by 1/2 inch, minimum.

E. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

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

G. Soil Retainers: Shall be provided where specified and shown on the drawings to prevent migration of backfill under suspended foundation elements:

1. Retainers shall be composed of high density polypropylene materials that are not adversely affected by moisture. They must be flexible, impact resistant and have sufficient strength to resist lateral loads applied by soil.

a. Thickness: 3/8” for void spaces.
b. Soil retainers shall extend six inches above the void forms and a minimum of 3 inches below the void forms.

2.2 STEEL REINFORCEMENT

A. Steel reinforcing shall conform to Section 3 of ACI 301.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

2.3 REINFORCEMENT ACCESSORIES

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

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

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

2.4 CONCRETE MATERIALS

A. Concrete materials shall conform to section 4 of ACI 301.

B. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I, II or III, gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class F.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Silica Fume: ASTM C 1240, amorphous silica.

D. Normal-Weight Aggregates: ASTM C 33, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

E. Water: ASTM C 94.

2.5 ADMIXTURES

A. Admixtures shall conform to Section 4 of ACI 301.

B. Air-Entraining Admixture: ASTM C 260.

C. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 WATERSTOPS

A. Flexible Rubber Waterstops: For embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
   1. Submit suggested product to Engineer for approval.

2.7 CURING MATERIALS

A. Curing materials shall conform to Section 5 of ACI 301.

B. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
   1. Submit suggested product to Engineer for approval.

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

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

E. Water: Potable.

F. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

   1. Submit suggested product to Engineer for approval.

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

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

C. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.9 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

   1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete to 25 percent:

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.10 percent by weight of cement.

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

1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.10 CONCRETE MIXTURES

A. All concrete site structures: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 3 to 5 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: 3 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.

2.11 FABRICATING REINFORCEMENT

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

2.12 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 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.

PART 3 - EXECUTION

3.1 FORMWORK

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

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

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

D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

E. 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.

F. Foundation Elements: The sides of all below grade portions of beams, pier caps, and columns shall be formed straight and to the lines and grades specified. Foundation elements shall not be earth formed unless specifically indicated on the Drawings.

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 VOID FORMS

A. Install void forms in all locations shown on the Drawings. In general, void forms shall be placed below all structural elements supported by piers to separate these elements from the earth.

B. Seal discontinuous ends of void forms and tape all joints with waterproof tape so that concrete will not enter the void space during placement of concrete. Do not leave gaps between void form sections.

C. Premanufactured void forms with circular edges shall be used around all drilled piers. Field fabrication of pier void forms is not permitted.

D. Do not allow any portion of void forms to fall within the circumference of piers causing a reduction in the bearing area.

E. Protect void forms from water. Do not install void forms during wet weather or on wet ground. Void forms which become saturated prior to placement of concrete shall be removed and replaced. Void forms shall not be wrapped in plastic, or other similar material to protect from moisture when installed.

F. Exercise care in placement of concrete to avoid collapse of void form. If void forms collapse, soil beneath the concrete shall be dug out and a proper void space shall be created by installing soil retainers on each side of element.

G. Void forms under slabs shall be protected by a layer of one-eighth inch thick protection board followed by a vapor barrier or retarder per the specifications. Do not install void forms under soil supported slabs on grade.

3.3 SOIL RETAINERS

A. Install soil retainers in straight, clean trenches at sides of void forms prior to concrete placement. The gaps between the trench and retainers must be properly positioned or backfilled prior to the placement of concrete. Do not cast the sides of concrete beams directly against the soil.

B. Affix the soil retainers to the concrete beam with adhesive, pin/washer/load, or concrete hard nails spaced on 24 inch centers.

3.4 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 75 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

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

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

3.5 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. 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.

3.6 VAPOR RETARDERS

A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.7 STEEL REINFORCEMENT

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

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

C. Development length and lap splices for reinforcement shall conform to ACI 318-14.

D. Longitudinal reinforcing in bond beams, walls, and footings shall be continuous around corners.

E. Concrete clear cover shall be as follows:
1. Concrete cast against earth: 3” minimum.
2. Concrete exposed to earth or weather:
   a. # 6 or larger: 2” minimum.
   b. # 5 or smaller: 2" minimum.
3. Concrete not exposed to earth or weather:
   a. Slabs and walls: 1” minimum.

b. Beams, girders and columns: 1 ½" minimum.

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

G. Installation tolerances:
1. Top and bottom bars in slabs, girders, beams, and joists:
   a. Members 8" deep or less: +/-3/8"
   b. Members more than 8" deep: +/-1/2"
2. Concrete cover to formed or finished surfaces: +/-3/8" for members 8" deep or les; +/-1/2" for members over 8" deep, except that tolerance for cover shall not exceed 1/3 of specified cover

H. Splices: Provide standard reinforcement splices by lapping and tying ends. Comply with ACI 318 for minimum lap of spliced bars where not specified on the documents.

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

3.8 JOINTS

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

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

B. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete

develops random contraction cracks. Sawcuts must be completed within 24 hours of completion of the slab pour, or prior to any shrinkage cracking in the slab.

C. Isolation Joints: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

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

3.9 WATERSTOPS

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

3.10 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. Do not add water to concrete during delivery, at Project site, or during placement unless approved by the Engineer.

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

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

2. Water content shall not exceed the maximum specified water/cement ratio for the mix.

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

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
4. Do not permit concrete to drop freely any distance greater than 20'-0" for concrete containing a high range water reducing admixture (superplasticizer) or 5'-0" for other concrete. Provide chute or tremie to place concrete where longer drops are necessary. Do not place concrete into excavations with standing water. If place of deposit cannot be pumped dry, pour concrete through a tremie with its outlet near the bottom of the place of deposit.
5. Pump priming grout shall be discarded and not used in the structure.

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 and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

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

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

1. 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. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.11 FINISHING FORMED SURFACES

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

1. Apply to concrete surfaces exposed to public view.

B. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. 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.

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

D. See Landscape specification 32 13 13 for information related to rock salt finished concrete.

3.12 INSTALLATION OF NON-SHRINK GROUT UNDER BASEPLATES

A. Grout under all bearing and baseplates. Comply with manufacturer's instructions. Do not dry pack.

B. Mixing: Use a mechanical mixer. Add only enough water to make grout placeable. Do not mix more grout than can be used in 20 minutes. Under no circumstances shall grout be retempered.

3.13 CONCRETE PROTECTING AND CURING

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

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

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

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

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

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.
b. Continuous water-fog spray.
c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch 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 certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

F. A minimum of 3-day compressive strength of 1800 psi shall be confirmed by the material testing agency prior to allowing construction personnel traffic on slab surfaces. Construction equipment traffic shall not be on slab surfaces prior to approval by the Engineer.

3.14 STRUCTURAL REPAIRS

A. Structurally Defective Concrete: Structural defects include spalls, honeycombs or rock pockets with exposed reinforcement, hollow-sounding concrete, cracks that penetrate to the reinforcement or completely through concrete elements, inadequate cover over reinforcement, and other conditions that affect the structural performance or durability of the concrete as determined by the Engineer.

B. Repair structural defects in concrete in accordance with plans, specifications, details, etc. provided by the Engineer.

1. The cost of the additional services provided by the Engineer to prepare the repair documents, and to oversee the repair work shall be borne by the Contractor.

C. Unapproved and defective repairs shall be removed and replaced in accordance with requirements provided by the Engineer at no additional cost to the Owner.

3.15 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test 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 removal of shores and forms from beams and slabs.

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

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture up to 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample.

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

5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample.

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

7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

9. Strength of each concrete mixture will be satisfactory if every average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

10. Test results shall be reported in writing to The Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.

12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by the Engineer.

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

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

END OF SECTION 033000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

Provide all labor, materials, equipment, services and transportation required to complete all concrete work as shown on Drawings, as specified herein, and as required by the job conditions. This Specification is not intended to address the particular requirements of Architectural Concrete.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Concrete Formwork	Section 031000
Concrete Reinforcement and Embedded Assemblies	Section 032000
Thermal and Moisture Protection	Division 7

1.4 CODES AND STANDARDS

A. Building Code: Concrete work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:
1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 237 – Self Consolidating Concrete.
3. ACI 301 – Specifications for Structural Concrete.
4. ACI 318 – Building Code Requirements for Structural Concrete and Commentary.
5. American Concrete Institute “Manual of Concrete Practice”, various committee reports as referenced herein.
6. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
7. AASHTO T318 – Standard Method of Test for Water Content of Freshly Mixed Concrete Using Microwave Oven Drying.

C. Definitions:
1. The term “Contract Documents” in this Specification is defined as the design Drawings and the specifications.
2. The term “SER” in this Specification is defined as the Structural Engineer of Record for the structure in its final condition.
3. The term “Design Professionals” in this Specification is defined as the Owner’s Architect and SER.
4. The term “Contractor” in this Specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Concrete Contractor and their sub-contractors.
5. The term “Testing Agency” in this Specification is defined as an independent testing and inspection service engaged by the Owner for quality assurance observation and testing of concrete construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
6. The terms “for record” and “submit for record” in this Specification are defined as Contractor submittals that do not require a response from the Design Professionals.
7. The term “Working Days” in this Specification is defined as Monday through Friday, excluding federal or state holidays.
8. The term “Delegated Design” in this Specification is defined as a scope of work that meets performance and design criteria established in the Contract Documents and is to be completed by the Contractor’s licensed engineer.

1.5 CONTRACTOR QUALIFICATIONS

A. The work of this section shall be performed by a company specializing in the type of concrete work required for this Project, with a minimum of 10 years of documented successful experience and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.

B. Contractor's Testing Agency Services: Required as specified in Division 1, and herein.
C. Materials and installed work may require testing and retesting at any time during progress of work, as directed by Design Professionals. Tests, including retesting of rejected materials for installed work will be done at Contractor's expense.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested. Reproduction of structural drawings for shop drawings is not permitted.

(1) Submittal Schedule
(2) Mix Designs
(3) Concrete Travel Times to the Project Site
(4) Hot and Cold Weather Procedures
(5) Product Data
(6) Concrete Joint Locations
(7) Comprehensive Layout Drawings
(8) Preconstruction Survey
(9) Survey of Flat Plate or Flat Slab Concrete Floors during construction
(10) FF/FL Testing
(11) Structural Repairs
(12) Patching Defective Concrete Finishes
(13) Conduit and Pipes Embedded in Concrete
(14) Hazardous Materials Notification

1. Submittal Schedule: The contractor shall submit for action a schedule at least twenty (20) working days prior to commencing submittals.
   a) This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for action at least twenty (20) working days before the modification or addition is proposed to take place.
   b) If at any time the total number of shop drawings received in any one week period exceeds the amount in the approved schedule by more than 10% for that week, the Design Professionals have the right to add two days to the average turnaround time for each 20% increment in excess of the scheduled quantity for that week's submissions. For example if the weekly total exceeds the schedule by 10% to 20%, two days may be added; if it is exceeded by 21% to 40%, four days may be added. The return dates for subsequent submittals may be extended based on the additional review time stated above.
   c) For the purposes of developing a schedule, assume the following review rate, Shop drawings – 10 full size sheets per week.
2. Mix Designs: Submit for action concrete mix designs for each type and strength of concrete required for this Project at least thirty (30) days before placing concrete.
   a) Mix designs shall be prepared or reviewed by an approved independent Testing Agency retained by the Contractor in accordance with requirements of ACI 301 and ACI 318, sealed and signed by a Professional Engineer licensed in the state where the project is located, and shall be coordinated with design requirements and Contract Documents.
   b) Before submitting to Owner's Testing Agency, submit complete mix design data for each separate mix to be used on the Project in a single submittal.
   c) Provide a completed "Concrete Mix Design Submittal Form" (attached to the end of this Specification Section) for each proposed concrete mix.
   d) Mix materials shall be from the same production facility that will be used for this Project.
   e) Mix Design data shall include but not be limited to the following:
      i. Locations on the Project where each mix design is to be used corresponding to Structural General Notes on the Drawings.
      ii. Design Compressive Strength: As indicated on the Drawings.
      iii. Proportions: ACI 301 and ACI 318.
      iv. Gradation and quality of each type of ingredient including fresh (wet) unit weight, aggregates sieve analysis.
      v. Water/cementitious material ratio.
      vi. Evaluation and classification fly ash in accordance with ASTM D 5759.
      vii. Report of chemical analysis of fly ash in accordance with ASTM C 618.

viii. Classification of blast furnace slag in accordance with ASTM C 989.
ix. Slump: ASTM C 143.
x. Certification and test results of the total water soluble chloride ion content of the design mix - AASHTO T260 or ASTM C 1218.
xi. Air content of freshly mixed concrete by the pressure method, ASTM C 231, or the volumetric method, ASTM C 173.
xii. Unit Weight of Concrete: ASTM C 138.
xiii. Design strength at 28, 56 or 90 days, as indicated on Contract Documents: ASTM C 39.
(1) Document strength based on basis of previous field experience or trial mixtures per ACI 301. Proportioning by Water-Cement Ratio is not permitted.
(2) Submit strength test records, mix design materials, conditions, and proportions for concrete used for record of tests, standard deviation calculation, and determination of required average compressive strength. Test records to support proposed mixtures shall be no more than 24 months old and use current cement aggregate sources. Test records to establish standard deviation may be older if necessary to have the required number of samples.
(3) If early concrete strengths are required, Contractor shall submit trial mixture results as required.
xiv. Manufacturer's product data for each type of admixture.
xv. Manufacturer's certification that all admixtures used are compatible with each other.
xvi. All information indicating compliance with Contract Documents including method of placement and method of curing.
xvii. Normalweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.
xviii. Lightweight Concrete: Density per ASTM C 138. Design the mix to produce the strength, modulus of elasticity and density as indicated on the Contract Documents.
(1) Where lightweight concrete members are used, provide split cylinder strength factor, fct, as indicated.
xix. Certification from a qualified testing agency indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity in accordance with ASTM C 33

3. Concrete Travel Times to the Project Site: Submit for record.
4. Hot and Cold Weather Procedures: Submit for record written procedures for placement of concrete in hot and cold weather conditions. Hot and Cold weather are as defined in the Concrete Placement section of this Specification.
5. Product Data: Submit for action product data clearly marked to indicate locations to be used and all technical information which specifies full compliance with this section and Contract Documents, including published application instructions, product characteristics, compatibility, and limitations for each of the following:
a) Bonding agents.
b) Curing compound and liquid sealer densifier. Submit for record to Design Professionals a written statement guaranteeing that the compound will not leave discoloration on concrete to be left exposed, or affect the bond for paint or other applied finishes. Include provision in written statement that in the event of failure of applied finishes to bond to membrane cured concrete, to remove the curing compound and leave suitable surfaces for bonding such finishes.
c) Absorptive covers and moisture retaining covers.
d) Vapor Retarder: See Division 7, Thermal and Moisture Protection.
e) Self-leveling concrete topping.
f) Grout: Submittal of grout by manufacturers not listed herein must be accompanied by independent certification of ASTM C 1107 compliance without modification of standard methods.
g) Other products proposed by Contractor
6. Concrete Joint Locations: Submit for action plans indicating locations and details of construction joints, contraction joints, waterstops, sleeves, embedments, etc. that interact with the joints. Contractor to coordinate joint location with reinforcement shop drawings. Reinforcement shop drawings shall indicate additional reinforcement bars where required at construction joints.
Joint locations for concrete slabs to receive a terrazzo or similar finish subject to reflective cracking must be coordinated with layout of finish drawings.
7. Comprehensive Layout Drawings: Submit for action comprehensive layout drawings (a single drawing per area/element):

a) Drawings shall show openings in structural members, including floor slab, shear walls, columns and beams.
b) Drawings shall consolidate the work of all trades and shall be coordinated by the Contractor.
c) Drawings shall show concrete accessories and embedded items, including fabrication details of items to be placed (exclusive of reinforcement).
d) Submit with or prior to reinforcement and formwork submittals for same element/area.

8. Preconstruction Survey: Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals.
9. Survey of Flat Plate or Flat Slab Concrete Floors during construction: Submit for record. Survey requirements are described on Drawings. Based on survey results, SER may propose adjustments to formwork and camber.
10. FF/FL Testing: Submit for record. Owner's Testing Agency to test and report flatness (F_F), levelness (F_L) prior to shoring removal. For slabs that include camber, do not test for levelness (F_L). Perform F_F/F_L testing in accordance with ASTM E 1155 requirements.
11. Structural Repairs: Submit for action procedures, intended locations, and product information. Alterations to design shall be sealed and signed by a Professional Engineer licensed in the state where the project is located.
12. Patching Defective Concrete Finishes: Submit for action procedures, intended locations, and product information.
13. Conduit and Pipes Embedded in Concrete: Submit for action layout of embedded conduit and pipes.
14. Hazardous Materials Notification: Submit for record. In the event no product or material is available that does not contain hazardous materials as determined by the Owner, a "Material Safety Data Sheet" (MSDS) equivalent to OSHA Form 20 shall be submitted for that proposed product or material prior to installation.

B. Submittal Process

1. Submittal of shop drawings and other submittals by the Contractor shall constitute Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each drawing with other Drawings and other trades. The Contractor shall place their shop drawing stamp on all submittals confirming the above.
2. Shop drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable Drawings used in the development of the shop drawings shall be referenced on each shop drawing to facilitate checking.
3. The Contractor shall submit to the Design Professionals one (1) electronic copy for shop drawing review. The naming convention of each drawing must follow the submittal numbering system and include the submittal number, Specification number, revision number and drawing number in the prefix of the drawing name.
4. The Contractor shall allow at least ten (10) working days between receipt and release by the SER for the review of shop drawings and submittals.
5. All modifications or revisions to submittals and shop drawings must be clouded, with an appropriate revision number clearly indicated. The following shall automatically be considered cause for rejection of the modification or revision whether or not the drawing has been approved by the Design Professionals:
   a) Failure to specifically cloud modifications
   b) Unapproved revisions to previous submittals
   c) Unapproved departure from Contract Documents
6. Resubmittals: Completely address previous comments prior to resubmitting a drawing. Resubmit only those drawings that require resubmittal. Do not include new content not previously reviewed.
7. Resubmittals Compensation: The Contractor shall compensate the Design Professionals for submittals that must be reviewed more than twice due to Contractors' errors. The Contractor shall compensate the Design Professionals at standard billing rates plus out-of-pocket expenses incurred at cost + 10%.
8. The Contractor shall deliver to the Design Professionals at the completion of the job two (2) copies of the electronic version of the final as-built shop drawings on a CD-ROM or other media acceptable to the Design Professionals.

C. SER Submittal Review

1. The Design Professionals' review and approval of shop drawings and other submittals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:

a) Conforming to the Contract Documents.
b) Coordination with other trades.
c) Responsibility for all required detailing and proper fitting of construction work.
d) The necessity of furnishing material and workmanship required by Drawings and Specifications which may not be indicated on the shop drawings.
e) Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.

2. TYPE 1 – Structural Submittal Review Stamp: For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require one of the following actions:
   a) APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
   b) APPROVED AS NOTED indicates that the SER requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.
   c) REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
   d) NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
3. TYPE 2 – Delegated Design Review Stamp: For submittals for building elements which are not designed by the SER but are delegated design items, or for items that do not form part of the completed structural system but impose loads on the structure, or for construction items or activities which have an effect on the final structure. The responses on the stamp used by the SER require one of the following actions:
   a) NO EXCEPTIONS indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
   b) EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.
   c) REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

D. Substitution Request
1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.
2. All substitutions must be requested using the structural substitution request form included at the end of this section. Acceptance using the structural substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The structural substitution request form, even if accepted, does not constitute a change order.
3. Accepted substitutions or modifications shall be coordinated and incorporated in the work at the sole expense of the Contractor.
4. The acceptance by the Design Professionals of a specific and isolated request by the Contractor to deviate from these requirements does not constitute a waiving of that requirement for other elements of, or locations in the project, unless specifically addressed as such and permitted by the Design Professionals in writing.
5. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated for the

review and/or incorporation of the Contractor-requested substitution, including indirect effects on other portions of the work, the Contractor is responsible for paying for additional work performed by the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

6. Contractor is responsible for means and methods and any impacts on other portions of the work that may arise from this substitution.

E. Request for Information (RFI)
1. RFIs shall be submitted by the Contractor. RFIs submitted by other entities will be returned with no response.
2. Limit RFI to one subject.
3. Submit RFI immediately upon discovery of the need for interpretation or clarification of the Contract Documents. Submit RFI within timeframe so as not to delay the Construction Schedule while allowing the full response time described below.
4. The response time for answering an RFI depends on the category in which it is assigned.
   a) Upon receipt by the SER, each RFI will be assigned to one of the following categories:
      i. No cost clarification
      ii. Shown in Contract Documents
      iii. Change to be issued in future document revision
      iv. Previously answered
      v. Information needs to be provided by others.
      vi. Request for corrective field work
      vii. Request for substitution
   b) RFIs in the first five categories listed above will be turned around by the SER on average of five (5) working days.
   c) RFIs in the last two categories listed above will be immediately rejected and must be submitted as submittals or requests for substitution.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Comply with General Conditions and Division 1.
B. Storage:
1. Store materials in accordance with ACI 304R.
2. Store cement in weather-tight buildings, bins or silos that will exclude moisture and contaminates.
3. Store admixtures to avoid contamination, evaporation, damage, and in accordance with manufacturer's temperature and other recommendations.
4. Keep packaged material in original containers with seals unbroken and labels intact until time of use.
C. Handling:
1. Handle fine and coarse aggregates as separate ingredients.
2. Arrange aggregate stockpiles to avoid excessive segregation, and prevent contamination with other materials or with other sizes of like aggregates.
3. Do not use frozen or partially frozen aggregates.
4. Allow sand to drain until it has reached relatively uniform moisture content before use.
5. Protect liquid admixtures from freezing and temperature changes that would adversely affect characteristics, and in accordance with manufacturer's recommendations.

1.8 PRE-INSTALLATION CONFERENCE
A. At least 30 working days prior to the start of concrete construction, the Contractor shall hold a meeting to review the approved concrete mix designs and to determine the procedures for producing proper concrete construction. The Contractor shall notify the Design Professionals of the meeting and require responsible representatives of every party who is concerned with the concrete Work to attend the conference, including but not limited to the following:
1. Contractor.
2. Owner’s Testing Agency representative
3. Concrete Subcontractor.
4. Ready-mix concrete producer.
5. Admixture manufacturer(s).
B. Minutes of the meeting shall be recorded and distributed by the Contractor to all parties concerned within five working days of the meeting. One copy of the minutes shall also be furnished to the following:
1. Design Professionals.
2. Owner's Representative.

C. The minutes shall include a statement by the concrete contractor and admixture manufacturer(s) indicating that the proposed mix design and placing, finishing, and curing techniques can produce the concrete properties and quality required by these Specifications.

1.9 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. Quality assurance is testing and inspection to assist the Owner in evaluating the Contractor's performance and quality control.

B. Cost: Except as specifically noted otherwise, the testing agencies for quality assurance shall be engaged and paid by the Owner.

C. Coordination with Owner's Testing Agency: The Contractor shall have sole responsibility for coordinating their work with the Owner's Testing Agency to assure that all test and inspection procedures required by the Contract Documents and Public Agencies are provided. The Contractor shall cooperate fully with the Owner's Testing Agency in the performance of their work and shall provide the following:
   1. Information as to time of starting field construction and concrete placement schedule, one week prior to the beginning of the work
   2. Site File: At least one copy of each approved shop drawing shall be kept available in the Contractor's field office. Drawings not bearing evidence of approval and release for construction by the Design Professionals shall not be kept on the job.
   3. Full and ample means of assistance for testing and inspection of material
   4. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field

D. Duties of the Owner's Testing Agency:
   1. Reports: The Testing Agency shall prepare daily reports of the concrete work including progress and description/area of work, tests made and results. The daily reports shall be collected and delivered to the Design Professionals and Owner weekly
   2. Concrete Strength Spreadsheet Log: The Test Agency shall maintain a log that contains the results of all concrete strength tests. The log shall include the results of each test performed, be in electronic spreadsheet format, and updated and submitted along with concrete test data. See example log attached at the end of this Specification Section.
   3. Rejection: The Owner's Testing Agency has the right to reject any material, at any time, when it is determined that the material or workmanship does not conform to the Contract Documents. The Testing Agency shall immediately notify the Owner, Design Professionals, and Contractor of deficiencies.
   4. Remedial Work: The Testing Agency shall indicate to the Contractor where remedial work must be performed and will maintain a current list of work not in compliance with the Contract Documents. This list shall be submitted to the Design Professionals and Owner on a weekly basis.
   5. Certification: When all work has been approved by the Testing Agency, the Testing Agency shall certify in a letter to the Design Professionals and Owner that the installation is in accordance with the design and Specification requirements.

E. Field Quality Assurance
   1. General: The Owner's Testing Agency shall test and inspect concrete materials and operations as Work progresses. Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered nor shall it obligate the Design Professional for final acceptance.
   2. Owner's Testing Agency is responsible for monitoring concrete placement as follows:
      a) Owner's Testing Agency shall provide qualified personnel at site to monitor concreting operations as follows:
         i. Verify use of required design mix
         ii. Record location of point of concrete discharge of each batch truck tested, cross referenced to grid lines.
         iii. Record temperature of concrete at time of placement.
         iv. Record weather conditions at time of placement, including temperature, wind speed, relative humidity, and precipitation.
         v. Record types and amounts of admixtures added to concrete at the project site.
         vi. Record amount of water added at the site and verify that total water content does not exceed amount specified in the mix design. Addition of water at the site is subject to prior approval by the Design Professional.
         vii. Monitor consistency and uniformity of concrete.
         viii. Monitor preparation for concreting operations, placement of concrete, and subsequent curing period for conformance with Specifications for following procedures:
            (1) Concrete curing.

(2) Hot weather concreting operations.
(3) Cold weather concreting operations.

3. Owner's Testing Agency shall conduct tests of concrete as follows and in accordance with ASTM C 1077:
   a) Testing frequency: Sample sets for all tests listed below of each concrete design mix placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards. (75 cubic meters) of concrete, nor less than once for each 5000 square feet (500 square meters) of surface area for slabs or walls. Additional tests shall be performed if deemed necessary by the Owner's Testing Agency and Design Professionals. In addition, sample each truckload used for columns, regardless of other frequencies listed above.
   b) Obtain each test sample from different batches selected on a strictly random basis before commencement of concrete placement. Record location in structure of sampled concrete.
   c) Determine air content of normalweight concrete in accordance with either ASTM C 231 or ASTM C 138. Determine air content of lightweight concrete in accordance with ASTM C 173. Conduct one test for air content for each strength test required or for every 50 cubic yards (40 cubic meters) of fly ash concrete placed, whichever is less.
   d) Determine unit weight of lightweight concrete in accordance with ASTM C 567.
   e) Test water content of freshly mixed concrete on a random basis, a minimum of once per 100 cubic yards (75 cubic meters) or every 5000 square feet (500 square meters) of concrete placement, during placement in accordance with AASHTO T 318 for the following concrete types:
      i. Hard troweled slabs exposed to view
      ii. Slab to receive a bonded finish floor material
      iii. Slabs with specified concrete compressive strength exceeding 6000 psi (42MPa)
   f) Conduct slump tests in accordance with ASTM C 143.
   g) Slump indicated in mix designs shall be achieved at point of placement. Correlation between slump at point of initial discharge from truck and point of placement must be established to determine amount of slump loss which occurs between initial discharge and point of placement. Adjustment may be necessary to achieve slump indicated in mix designs at point of placement.
   h) Conduct slump tests for Self Consolidating Concrete (SCC) as follows
      i. In accordance with ACI 237, where SCC is used, perform slump flow and visual stability index tests in accordance with ASTM C1611 on the first batch of SCC, and then consecutive batches until two consecutively produced batches are within specification. SCC with a visual stability index value of 2 or 3 shall be stabilized, where possible, with a viscosity modifying admixture or rejected at the discretion of the Engineer and Ready Mix Quality Control Representative. The Ready Mix Producer shall be responsible for adjusting the mix to provide desired flow and stability. After establishing the consistency of the SCC mix, testing shall continue in accordance with the requirements of the above paragraph.
      ii. In accordance with ACI 237, where SCC is used, perform slump flow tests in accordance with ASTM C1621 using a J-ring to determine the passing ability of the SCC mix around reinforcement. If the reinforcing bars retain the coarse aggregates inside the ring, the mixture has a high potential for blocking and should be reproportioned at the direction of the Engineer and Ready Mix Quality Control Representative.
   i) Conduct strength tests of concrete as follows:
      i. Secure sample sets in accordance with ASTM C 172.
      ii. Mold cylinders in accordance with ASTM C 31 and cure under standard moisture and temperature conditions in accordance with ASTM C 31, Section 7 (a). Quantity of cylinders listed below is based on a cylinder size of 4 inch (100mm) diameter x 8 inches (200mm) long. If 6 inch (150mm) diameter by 12 inch (300mm) long cylinders are used, the total quantity of cylinders may be reduced by one with two cylinders instead of three tested at the age designated for determination of f'c.
      iii. Test cylinders in accordance with ASTM C 39. For specified concrete strength of 10,000 psi (70MPa) and above, cylinders shall be ground and not capped.
      iv. For 28 day mixes mold six cylinders. Test two cylinders at seven days and three cylinders at 28 days. The 28 day strength shall be the average of the three 28 day cylinders. One cylinder shall be retained in reserve for later testing if required.
      v. For 56 day mixes mold seven cylinders. Test one cylinder at seven days, two cylinders at 28 days, and three cylinders at 56 days. The 56 day strength shall be the

average of the three 56 day cylinders. One cylinder shall be retained in reserve for later testing if required.

vi. For 90 day mixes mold eight cylinders. Test one cylinder at seven days, one at cylinder at 28 days, two cylinders at 56 days, and three cylinders at 90 days. The 90 day strength shall be the average of the three 90 day cylinders. One cylinder shall be retained in reserve for later testing if required.

vii. When high early strength concrete is required by Contractor, additional cylinders shall be made and tested as required at Contractor's expense.

viii. If one cylinder in a test manifests evidence of improper sampling, molding or other damage, discard cylinder and base test results on that of remaining cylinder.

4. Owner's Testing Agency shall evaluate concrete for conformance with Specifications as follows:
   a) Slump:
      i. Owner's Testing Agency shall maintain a slump moving average, comprised of the average of all batches or most recent five (5) batches tested, whichever is fewer.
   b) Strength test:
      i. Owner's Testing Agency shall maintain a compressive strength moving average, comprised of three (3) consecutive strength test results, for each mix design used in Work.
      ii. Strength level of concrete will be considered satisfactory provided averages of all sets of three (3) consecutive strength test results (i.e. moving average) equal or exceed specified 28-day strength, and no individual strength test result falls below specified 28-day strength by more than 500 psi (3.5MPa).
      iii. If strength tests fail to meet minimum requirements, concrete represented by such tests shall be considered questionable and shall, if deemed appropriate by the SER, be subject to further evaluation by core testing as specified herein or other testing methods.
   c) Conduct core tests on questionable concrete in accordance with ACI 318 and ASTM C 42.
      i. Location of cores shall be coordinated with Design Professionals so as to least impair strength of structure. Before testing cores, discard and replace any that show evidence of having been damaged subsequent to or during removal from structure or which have reinforcement present.
      ii. Cores from structure exposed to soil or constant moisture in service (e.g. basement walls, retaining walls, slab-on-grade, piers, footings, etc.) shall be tested in a fully saturated condition. Cores for all other concrete may be tested dry. Prior to commencement of coring, verify with Design Professionals whether cores are to be tested wet or dry.
      iii. Fill core holes with low slump concrete or mortar with a strength equal to or greater than that specified for area cored.
   d) Concrete in area represented by core test will be considered adequate if average strength of cores is equal to at least 85% of, and if no single core is less than 75% of specified strength.
5. Floor flatness and levelness tolerance compliance testing is to be performed within 72 hours of concrete placement by Owner's Testing Agency, and prior to the removal of shores and forms.

F. Owner's Testing Agency shall submit for record inspection, observation, and/or test reports to the Owner and Design Professionals, as required herein and shall provide an evaluation statement in each report stating whether or not concrete placement conforms to requirements of Specifications and Drawings and shall specifically note deviations therefrom.

G. Immediately report deficiencies to the Contractor, Owner and Design Professionals.

1.10 QUALITY CONTROL BY CONTRACTOR

A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.

B. The Owner's general review during construction and activities of the Owner' Testing Agency are undertaken to inform the Owner of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.

C. The Contractor shall immediately notify the Design Professionals of any deficiencies in the work which are departures from the Contract Documents. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Owner, the Contractor shall correct the deficiency at no cost to the Owner. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in the OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS section of this Specification.

D. Where SCC is used, the Ready Mix Producer shall have a Quality Control Representative on site during placements until mix consistency and stability is established.

1.11 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

A. Observations: The Design Professionals will observe the construction for general compliance with the provisions of the Contract Documents during various phases of construction.

B. Corrections by Design Professionals: See Part 3 - CORRECTIVE MEASURES section of this specification.

1.12 PERMITS AND WARRANTY

A. Permits: The Contractor shall apply for, procure, renew, maintain, and pay for all permits required by City, State, or other governing authorities, necessary to execute work under this Contract. Contractor shall furnish copies of all permits to the Owner and Design Professionals.

B. Warranty: Comply with General Conditions, agreeing to repair or replace specified materials or Work that has failed within the warranty period. Failures include but are not limited to the following:

1. Oily, waxy or loose residue which may interfere with the bonding or discoloration of various applied Architectural finish materials.
2. Discoloration of concrete surfaces scheduled to remain exposed as a finish.
3. Areas which show surface failure or defects.
4. Areas which puddle water.
5. Areas which are not properly prepared to receive Architectural finish materials. If necessary, the Contractor, at his own expense, shall have the Owner’s Testing Agency perform appropriate tests for bond and discoloration.
6. Patches that become crazed, cracked or sound hollow when tapped.
7. Self-leveling concrete topping that has cracked, spalled and/or not performed in accordance with manufacturer's design criteria.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS & PRODUCTION

A. Portland Cement:

1. ASTM C150, Type I or Type II
2. ASTM C150, Type III, High-early Strength Portland Cement may be used subject to review and approval of the SER. The specified 28-day concrete compressive strength shall occur within 7 days for concrete using Type III Portland Cement.
3. Provide the same brand of Portland Cement from a single source throughout the project, as required to meet Design Professionals’ requirements.
4. Provide Portland Cement that is uniform in color.

B. Aggregates for Normalweight Concrete:

1. ASTM C 33
2. Fine Aggregate: Natural sand, or sand prepared from stone or gravel, clean, hard, durable, uncoated and free from silt, loam and clay.
3. Provide aggregates from a single source throughout the project for exposed concrete.
4. The acceptability of aggregates for the work will depend on proof that their potential alkali reactivity is not deleterious to the concrete.
5. Do not use fine or coarse aggregates that contain substances that cause spalling.
6. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed the following:
   Size no. 57 (25mm max) for footings, drilled piers and caissons
   Size no. 67 (20mm max) for all other locations
   Size no. 467 or 457 for non-reinforced concrete at locations noted on Drawings.
7. Contractor shall furnish concrete with maximum 3/8" (10mm) aggregate at no additional cost to the Owner if areas of high reinforcement density require it for placement and consolidation.

C. Aggregates for Lightweight Concrete:

1. ASTM C 330: Except aggregates prepared by processing natural materials, such as pumice, scoria, or tuff.
2. Classification of Aggregates: As required to meet Design Professional’s requirements.
3. Provide aggregates from a single source throughout the project for exposed concrete.
4. Aggregate shall contain the minimum absorbed moisture content recommended by the manufacturer for the project prior to batching.

5. Maximum coarse aggregate size shall conform to the requirements as specified in ACI 301 but shall not exceed ¾" (20mm)

D. Water: ASTM C 94. Clean, and free from injurious amounts of oil, acids, alkali, salts, organic material, or other deleterious materials.

E. Supplementary Cementitious Material
1. Fly Ash:
   a) ASTM C 618, Class C or Class F.
   b) Shall not be used unless part of an approved mix design.
   c) Limit Loss on Ignition to 2.5%
2. Ground Granulated Blast-furnace Slag (GGBFS)
   a) ASTM C 989.
   b) Shall not be used unless part of an approved mix design.
3. Silica Fume (Microsilica):
   a) ASTM C 1240
   b) Acceptable Product: W. R. Grace "Force 10,000 D"
   c) Acceptable Product: Euclid Chemical Company "Eucon MSA"
   d) Acceptable Product: BASF "MasterLife SF 100"
   e) Acceptable Product: Sika Corporation "Sikacrete 950 DP"
4. For concrete subject to Exposure Class F3 conditions as defined in ACI 318, Table 4.2.1, limit the maximum content of supplementary cementitious materials to values shown in ACI 318, Table 4.4.1.
5. The exact percentages used shall be based on successful test placement on site. Resubmit mix design if percentages change based on test placement.
6. The fly ash or natural pozzolan supplier shall have an effective quality control program in place to guard against contamination of the fly ash and assure compliance with Specifications.
7. Fly ash and GGBFS used shall be from one source throughout the project. Substitution of sources will be acceptable only if testing of concrete mixes containing the substituted material show similar test results and if the color of concrete produced with the substituted material matches the color of previously poured concrete to the satisfaction of the Architect.

F. Ready Mixed Concrete:
1. Shall be batch-mixed and transported in accordance with ASTM C 94.

G. Self-Consolidating Concrete:
1. Produce in accordance with ACI 237R.
2. Perform the following tests and provide report prior to submitting mix design:
   a) Resistance to Segregation: Achieve a maximum static segregation percentage of 15% when tested according to ASTM C 1610 with a VSI index of 1 maximum.
   b) Slump Flow: ASTM C 1611 within a range of 20"-30" (500mm–750mm).
   c) Passing Ability: ASTM C 1621 with a maximum difference of 2" (50mm) between testing with and without the J-Ring.

2.2 CONCRETE MIX DESIGN

A. Concrete Strength:
1. Shall be as indicated on the Structural Drawings

B. Concrete Density (Unit Weight):
1. Shall be as indicated on the Structural Drawings

C. Air Entrainment
1. For concrete exposed to freeze/thaw cycles and/or deicing chemicals (Exposure Classes F1, F2, F3), and concrete intended to be watertight, provide entrained air content of 6% ± 1.5%, unless specified otherwise. This includes, but is not limited to, concrete at the following locations:
   a) Concrete at the exterior of the structure with at least one surface exposed to weather, such as exterior face of grade beams, foundation walls, exterior walls and parapets, exposed columns and edge beams.
   b) Concrete in parking garages.
   c) Ramps and loading docks.
   d) Balconies and terraces with no waterproof membrane.
2. For lightweight concrete less than 120 pcf (19 kN/m³) density, air content may be up to 7% regardless of exposure condition.
3. For concrete with a specified compressive strength (f'c) greater than 5000 psi (35MPa), required air content may be reduced to 5% ± 1.5%.
4. Entrained air content noted above shall occur at point of delivery.
5. No entrained air content is required in concrete placed in the foundation with no surface exposed to weather.

6. All interior steel trowel finished, normalweight slabs shall have a maximum air content of 3%.

D. Water-Cementitious Materials (W/cm) Ratio for Normalweight Concrete
1. Unless lower limits are stated in the Contract Documents, all concrete exposed to freezing and thawing in moist condition (Exposure Classes F1 and F2) and/or required to be watertight shall have a maximum W/cm ratio of 0.45 and a minimum f'c=4500 psi .
2. All concrete exposed to deicing salts, brackish water seawater or spray from these sources (Exposure Class F3) shall have a maximum W/cm ratio of 0.40 and a minimum f'c=4500 psi.
3. Absent the above conditions, all concrete with required strength of 4000 psi (28MPa) or higher shall have a maximum W/cm ratio of 0.50.
4. The water-cementitious materials ratio shall not exceed values indicated, including any water added to meet specified slump in accordance with the requirements of ASTM C 94.
5. Weight of fly ash or pozzolanic admixtures shall be included with the weight of cementitious materials used to determine the water-cementitious materials ratio.

E. Slump
1. Concrete design mixes shall be proportioned to meet the following slump limitations. Slump should be measured as described in the Owner's testing agency responsibilities:
a) Concrete with high range water-reducing admixture: Concrete slump prior to addition of high range water-reducing admixture shall not exceed 3" (75mm) for normal weight concrete and 4" (100mm) for lightweight concrete. After addition of water-reducing admixture, the concrete shall have a maximum slump of 9" (225mm) unless otherwise approved by the SER.
b) Concrete without a water-reducing admixture: Slump shall not exceed 4".

F. Self-Consolidating Concrete Slump/Flow: Use for concrete exposed to view and heavily reinforced areas where indicated on the plans, and where conventional mixtures do not provide adequate consolidation. Minimum slump/flow diameter of 20" (500mm) or as required by the successful test placement onsite, which shall verify proper workability, finish, and setting time. All self-consolidating concrete shall contain the specified high range water-reducing admixture. All self-consolidating concrete shall contain viscosity modifying admixture as required unless proper quantity and grading of fines can be achieved.

G. Chloride Ion Content
1. The total water-soluble chloride ion content of the mix including all constituents shall not exceed the limits defined in ACI 318 4.3 unless corrosion inhibiting admixtures are added to the mixture to offset the additional chloride.
2. If the specified level of water-soluble chloride ion content cannot be maintained, appropriate level of corrosion inhibiting admixture shall be added to the mix in accordance with the manufacturer's recommendation to offset the excess amount of chloride at no additional cost to the Owner.

2.3 ADMIXTURES

A. General:
1. Admixtures specified below can be used only when established in the mix design with Design Professionals' prior written approval.
2. Each admixture approved by Design Professionals shall be used in strict compliance with manufacturer's published instructions.
3. Concrete supplier shall certify all admixtures to be compatible with each other. (See Submittals Section in Part 1)

B. Air Entraining Admixture:
1. ASTM C 260
2. Acceptable Product: BASF "MasterAir AE 200"" or "MasterAir -AE 90"
3. Acceptable Product: W. R. Grace "Darex Series" or "Daravair Series"
4. Acceptable Product: Euclid Chemical Company "AEA –92 or Air 40"
5. Acceptable Product: Sika Corporation "Sika Air Series" or "Sika AEA Series"

C. Water-Reducing Admixture:
1. ASTM C 494, Type A
2. Acceptable Product: BASF' "MasterPozzolith 210"
3. Acceptable Product: Euclid Chemical Company "EUCON NW" or "EUCON WR 91"
4. Acceptable Product: W. R. Grace "WRDA' Series, Zyla Series or "Mira" Series
5. Acceptable Product: Sika Corporation "Plastocrete Series"

D. Retarding Admixture:
1. ASTM C 494, Type B
2. Acceptable Product: BASF "Masterset R 100"
3. Acceptable Product: Euclid Chemical Company "EUCON RETARDER 100"
4. Acceptable Product: W. R. Grace "Daratard 17"
5. Acceptable Product: Sika Corporation "Plastiment Series"

E. Non Corrosive Accelerating Admixture:
   1. ASTM C 494, Type C
   2. Acceptable Product: BASF "POZZUTEC 20" or "Masterset NC 534"
   3. Acceptable Product: Euclid Chemical Company "ACCELGUARD 80", "ACCELGUARD NCA" or "ACCELGUARD 90"
   4. Acceptable Product: W. R. Grace "Daraset" Series, "Polarset", or "DCI"
   5. Acceptable Product: Sika Corporation "Sikaset NC" or "Plastocrete 161 FL" or "Sika Rapid-1"

F. Water-Reducing and Retarding Admixture:
   1. ASTM C 494, Type D
   2. Acceptable Product: BASF "Masterset R 100"
   3. Acceptable Product: Euclid Chemical Company "EUCON RETARDER 75" or "EUCON DS"
   4. Acceptable Product: W. R. Grace "Daratard 17" or "Recovery Series"
   5. Acceptable Product: Sika Corporation "Plastiment Series"

G. Water-Reducing and Accelerating Admixture:
   1. ASTM C 494, Type E
   2. Acceptable Product: BASF "Masterset FP 20"
   3. Acceptable Product: Euclid Chemical Company "ACCELGUARD 80" or "ACCELGUARD 90"
   4. Acceptable Product: W. R. Grace "Libricon NCA"
   5. Acceptable Product: Sika Corporation "Sikaset NC" or "Plastocrete 161 FL"

H. Mid-Range Water-Reducing Admixture:
   1. ASTM C 494, Type A
   2. Acceptable Product: BASF "MasterPolyheed Series"
   3. Acceptable Product: W. R. Grace "Daracem" or "Mira"
   4. Acceptable Product: Sika Corporation "Sikaplast Series" or "Sikament Series"
   5. Acceptable Product: Euclid Chemical Company: "Eucon MR" or "Eucon MRX"

I. High-Range Water-Reducing Admixture:
   1. ASTM C 494, Type F
   2. Acceptable Product: BASF "PS 1466" or "MasterGlenium Series"
   3. Acceptable Product: Euclid Chemical Company "EUCON 37" or "PLASTOL SERIES"
   4. Acceptable Product: W. R. Grace "Daracem" or "ADVA" Series
   5. Acceptable Product: Sika Corporation "Viscocrete Series" or "Sikament Series"

J. High-Range Water-Reducing and Retarding Admixture:
   1. ASTM C 494, Type G
   2. Acceptable Product: Euclid Chemical Company "EUCON 537"
   3. Acceptable Product: W. R. Grace "Daracem Series" or "Adva Series"

K. Viscosity Modifying Admixture (VMA) for Self-Consolidating Concrete (SCC):
   1. Acceptable Product: BASF "MasterMatrix VMA Series""
   2. Acceptable Product: W.R. Grace "V-MAR3"
   3. Acceptable Product: Euclid Chemical Company "EUCON ABS" or "EUCON WO" or "Visctrol"
   4. Acceptable Product: Sika Corporation "Sika Stabilizer Series"

L. Corrosion Inhibiting Admixtures:
   1. Calcium Nitrite Based: ASTM C 494, Type C, 30% + 2% solution
      a) Acceptable Product: W.R. Grace "DCI or DCI-S'
      b) Acceptable Product: Euclid Chemical Company "EUCON CIA"
      c) Acceptable Product: Sika Corporation "Sika CNI"
   2. Amine Carboxylate Based: ASTM C 1582, which includes ASTM C-494 amine carboxylate
      a) Acceptable Product: Cortec Corporation "MCI 2005", "MCI 2005 NS", "MCI 2006" or "MCI 2006 NS"
   3. Amino Alcohol Based:
      a) Acceptable Product: Sika Corporation "Sika FerroGard 901"

M. Shrinkage Reducing Admixtures:
   1. ASTM C 157
   2. Acceptable Product: W.R. Grace "Eclipse 4500" (for use with air-entrained concrete exposed to freeze/thaw), or "Eclipse Floor 200"
   3. Acceptable Product: Euclid Chemical Company "EUCON SRA" or "Conex"

N. Permeability-Reducing Admixture:
   1. ASTM C494, Type S
   2. Shall be a Portland cement based crystalline capillary waterproofing admixture that reacts in concrete to form non-soluble crystalline hydration products in the capillary pores of concrete,
   3. Acceptable Products
      a) MasterLife 300D by BASF Coroporation
      b) Eucon Vandex AM-10 by Euclid Chemical Company

c) Admix C-Series by Xypex

2.4 ADHESIVES

A. Bonding Agent for Cured Concrete (existing concrete damp or dry, at least 28 days old, no surface water):
1. ASTM C 881 Type I and IV, Grade 3, Class B and C.
2. Acceptable Product: BASF "CONCRESIVE PASTE (LPL)", Class C Only
3. Acceptable Product: BASF “CONCRESIVE LIQUID (LPL)”, Class C Only for bonding topping
4. Acceptable Product: Euclid Chemical Company “EUCO #452 Epoxy System”
5. Acceptable Product: Euclid Chemical Company “DURALCRETE LV Series”
6. Acceptable Product: Euclid Chemical Company “FLEXOCRETE System” for bonding topping

B. Bonding Agent for Uncured Concrete: (existing concrete damp or dry, less than 28 days old, no surface water):
1. ASTM C 881, Type II and V, Grade 2, Class B and C.
2. Acceptable Product: Euclid Chemical Company “DURALCRETE MV System”
3. Acceptable Product: Sika Corporation “Sikadur 32 Hi-Mod”

C. Anti-Corrosive Epoxy Cementitious Bonding Compound and Corrosion Protection of Reinforcement (bonding agent for existing concrete saturated surface dry, no surface water):
This adhesive shall be a water-based epoxy/cementitious compound for adhesion and corrosion protection of reinforcing members (20 hour maximum open time).
1. Acceptable Products: Euclid Chemical Company “DURALPREP AC”
2. Acceptable Products: Sika Corporation “ARMATEC 110"

D. Adhesive Between Cured Concrete Elements:
1. ASTM C 881 Type I and IV, Grade 3, Class B and C
2. Acceptable Product Sika Corporation “Sikadur 31 Hi-Mod Gel (1:1 Mix Ratio)

2.5 CURING COMPOUNDS AND SEALERS

A. Interaction with finishes:
1. See architectural Drawings for finish material applied over concrete.
2. Use only curing and sealer compounds that are compatible with finish material.
3. Manufacturer's certification is required.
4. Where finish material is liquid rubberized asphalt, use only strippable type curing compound.

B. Curing and Sealing Compound (VOC Compliant, 350 g/l) :
1. ASTM C1315, Type I, Class A and ASTM C 309, Type 1, Class A or B
2. Water based acrylic, clear, 25% solids curing and sealing compound.
3. Acceptable Product: Euclid Chemical Company "Super Diamond Clear VOX"
4. Acceptable Product: Dayton Superior “Cure & Seal J22WB)
5. Acceptable Product: BASF (Sonneborn) “Kure 1315”
6. Acceptable Product: W.R. Meadows “VOCOMP-25”

C. Curing Compound-Dissipating/Strippable (VOC Compliant, 350 g/l):
1. ASTM C 309, Type I, Class A or B
2. Water based resin, clear curing compound that begins to dissipate when exposed to UV light and traffic.
3. Acceptable Product: Euclid Chemical Company “Kurez DR VOX” (Dissipating) or “Kurez RC” in combination with “Kurez RC-Off” (Strippable)
4. Acceptable Product: Dayton Superior “Clear Resin Cure J11W"
5. Acceptable Product: W.R. Meadows: “1100 Clear”

2.6 SEALERS

A. Surface Sealer:
1. ASTM C 309, Type I, Class A or B
2. Water based acrylic sealing compound.
3. Acceptable Product: Euclid Chemical Company “DIAMOND CLEAR VOX”
4. Acceptable Product: Dayton Superior “Cure & Seal 309 EF”
5. Acceptable Product: BASF ”MasterKure CC 200WB”
6. Acceptable Product: “W.R. Meadows “VOCOMP 20”

B. Liquid Densifier/Sealer:
1. The liquid densifier compound shall be a silicate based compound that penetrates and chemically hardens concrete surfaces.
2. Acceptable Product: Euclid Chemical Company “Euco Diamond Hard”
3. Acceptable Product: Dayton Superior “Densifier J13”
4. Acceptable Product: BASF ”MasterKure HD 200WB”

5. Acceptable Product: W.R. Meadows “Liqui-Hard”

C. Top surface Retarders
1. Acceptable Product: GCP Top-cast Top Surface Retarder

2.7 DRY SHAKE HARDENERS

A. Mineral Aggregate Hardener:
1. The specified mineral aggregate hardener shall be formulated, processed and packaged under stringent quality control at the manufacturer's owned and controlled factory. The hardener shall be a factory-blended mixture of specially processed graded mineral aggregate, selected Portland cement and necessary plasticizing agents
2. Acceptable Product: Euclid Chemical Company, "Surflex" to be used with “Kurez DR VOX”
3. Acceptable Product: BASF, ”MasterTop 100 to be used with “Masterkure CC 200WB”
4. Acceptable Product: L&M Construction Chemicals “Ferrocon FF” to be used with “Dress & Seal WB 30”

B. Non-Oxidizing Metallic Hardener:
1. The specified non-oxidizing metallic floor hardener shall be formulated, processed and packaged under stringent quality control at the manufacturer’s owned and controlled factory. The hardener shall be a mixture of specially processed non-rusting aggregate, selected Portland Cement and necessary plasticizing agents.
2. Acceptable Product: Euclid Chemical Company, “Diamond-Plate” to be used with “Kurez DR VOX”
3. Acceptable Product: BASF ”MasterTop 210COR” to be used with “MasterKure CC 200WB”

2.8 MISCELLANEOUS CONCRETE PRODUCTS

A. Nonshrink Grout
1. Provide pre-packaged natural aggregate grout, high-precision, nonshrink, ready-to-use, complying with the following requirements:
a) See General Notes for grout minimum compressive strength.
b) Grout shall conform to ASTM C 1107
2. All material used including water, mixer and pre-packaged grout must be initially at the 45°F (7°C) and 90°F (32°C) limits when testing is initiated.
3. Acceptable Product: BASF "MASTERFLOW 928"
4. Acceptable Product: Euclid Chemical Company “HI-FLOW GROUT”
5. Acceptable Product: Five Star Products “Five Star Grout”
6. Acceptable Product: Sika Corporation “Sikagrout 328”

B. Self-Leveling Concrete Topping - Underlayment for Interior Applications:
1. Use self-leveling underlayment concrete formulated to level concrete floors without shrinking, cracking or spalling, and capable of being placed from feathered edge to 1" (25mm) thickness without aggregate in one pour. If greater than 1" (25mm) thickness is required, aggregate shall be used in accordance with manufacturer's requirements. Appropriate primer shall be utilized for all underlayment applications.
2. Acceptable Product: Ardex Engineered Cements "ARDEX K-15"
3. Acceptable Product: Euclid Chemical Company “Flo-Top or Super Flo-Top”
4. Acceptable Product: Sika Corporation “Sika Level Series”

2.9 MISCELLANEOUS PRODUCTS

A. Evaporation Retarder:
1. Acceptable Product: BASF "Masterkure ER50”
2. Acceptable Product: Euclid Chemical Company “Eucobar”
3. Acceptable Product: Sika Corporation “Sika Film”

B. Moisture-Retaining Covers:
Conforming to ASTM C171. A naturally colored, non-woven polypropylene fabric with a 4-mil non-perforated reflective (white) polyethylene coating containing stabilizers to resist degradation from ultraviolet light. Fabric shall exhibit low permeability and high moisture retention.
1. Hydracure S-16 by PNA Construction Technologies, Inc., Matthews, NC
2. Transguard 4000 by Reef Industries (Armorlon Division), Incorporated, Houston TX

C. Sand Cushion: Clean, manufactured or natural sand.

D. Expanded Polystyrene (EPS) used as Fill - Geofoam
1. Material: Rigid, closed cell polystyrene blocks formed by expansion of polystyrene beads by steam.
2. Comply with the requirements of ASTM D 6817
3. Unless noted otherwise on the drawings, provide the following types of EPS:

a) Fill between a lower slab and a raised slab area: EPS12 -2.2 psi (15 kPa) compressive resistance minimum at 1% deformation, 10 psi (70 kPa) flexural strength minimum
b) Typical below interior floor slabs supported on grade (soil fill over EPS fill) or directly on EPS fill: EPS15 - 3.6 psi (25 kPa) compressive resistance minimum at 1% deformation, 25 psi (170 kPa) flexural strength minimum
c) Fill below exterior floor slabs or slabs with truck loading: EPS19 - 5.8 psi (40 kPa) compressive resistance minimum at 1% deformation, 30 psi (200 kPa) flexural strength minimum

4. Thickness as indicated on Drawings.
5. Execution: Conform to manufacturer's instructions regarding preparation, installation and protection
6. Gripper plates shall be used as needed to restrain EPS from moving laterally in multi-layer applications
7. Contractor shall sequence soil or concrete topping placement to avoid EPS block shift or flotation.
8. Submit the following for review:
   a) Manufacturer's product literature including physical properties in compliance with ASTM D 6817 and type specified
   b) 10 year physical property warranty
   c) Proposed plan layout of fill blocks showing gaps between blocks where required for stabilizing and/or load bearing reinforced concrete ribs as shown on drawings, in details or in notes.
9. Submit the following for record:
   a) Summary of test compliance with specified performance characteristics and physical properties
   b) Product Certificates showing evidence of third party quality control
10. Acceptable product: Foam Control EPS Geofoam by AFM Corporation, Lakeville, MN
11. Acceptable product: EPS Geofoam by Styrotech, Brooklyn Park, MN
12. Acceptable product: EPS Geofoam by Universal Foam Products, Hunt Valley, MD
13. Acceptable product: EPS Geofoam by Dyplast Products, Miami, FL

E. Vapor Retarder: See Division 7, Thermal and Moisture Protection
1. Minimum 15-mil thick polyolefin geomembrane
2. Manufactured with prime virgin resins
3. Water Vapor Retarder: ASTM E 1745, meets or exceeds Class A
4. Water Vapor Transmission Rate: ASTM E 96, 0.008 gr./ft2/hr. (0.086 gr./m²/hr) or lower
5. Permeance Rating: ASTM E 96, 0.03 Perms or lower for new material and after conditioning tests in accordance with applicable sections of ASTM E 154
6. Puncture Resistance: ASTM E 1745,minimum 2400 grams
7. Tensile Strength: ASTM E 1745, minimum 45.0 lbs./in (8.0 kg/cm).
8. Acceptable product: W.R.Grace, "Florprufe 120"
9. Acceptable product: W. R. Meadows, "Perminator"
10. Acceptable product: Stego Industry LLC, "Stego Wrap"
11. Acceptable product: Raven Industries, "Raven Vapor Block 15".

F. Non-Slip Aggregate:
1. Abrasive aggregate shall be composed of an aluminum oxide abrasive bonded by a vitreous ceramic material. Use hard, homogeneous, non-glazing, rustproof aggregate which is unaffected by moisture or cleaning compounds.
2. Acceptable Product: Euclid Chemical Company "NON-SLIP AGGREGATE"
3. Acceptable Product: North Company "Alundum"
4. Acceptable Product: Anti-Hydro International "A-H A-2 Emery Shake-On" or "A-H Alox"

2.10 CONCRETE REPAIR MATERIALS

A. Polymer Repair Mortar
1. The following patching mortars may be used when color match of the adjacent concrete is not required. Prior approval by the Design Professionals is required.
2. Acceptable Products (Horizontal Repairs): Euclid Chemical Company "Thin Top Supreme or Tammspatch II" (for 1/16" (2mm) to 3/8" (10mm) thickness), or "Concrete Top Supreme" (for 3/8" (10mm) to 2" (50mm) thickness).
3. Acceptable Products (Horizontal Repairs): Sika Corporation "Sikatop 121 Plus" or "Sikatop 122 Plus".
4. Acceptable Products (Vertical and Overhead Repairs): Euclid Chemical Company "Verticoat", "Verticoat Supreme", or "Duraltop Gel"
5. Acceptable Products (Vertical and Overhead Repairs): Sika Corporation, "Sikatop 123 Plus".

6. Acceptable Products (Horizontal, Vertical and Overhead Repairs): BASF, “EMACO 100”

B. High Strength Flowing Repair Mortar
1. For forming and pouring structural members, or large horizontal repairs, provide the flowable one-part, high strength microsilica modified repair mortar with 3/8” (10mm) aggregate.
2. The product shall achieve 9000 psi (62MPa) @ 28-days at a 9-inch (225mm) slump.
3. Prior approval by the Design Professionals is required for cold weather applications
4. Acceptable Product: Euclid Chemical Company “Eucocrete”
5. Acceptable Product: BASF “EMACO S” Series
6. Acceptable Product: Sika Corporation “Sika Repair 211 SCC Plus”

C. Repair Topping
1. Latex and microsilica modified cementitious mortar topping, which meets or exceeds the bond strength requirements of ASTM C 1059.
2. Resistance to wear: The finished topping shall show a depth of wear of 0.2 mm (0.0079”) or less when tested at 28 days with a Chaplin Abrasion Tester.
3. Acceptable Products: Euclid Chemical Company, “Thin-Top Supreme or Tammspatch II”
4. Acceptable Product: Sika Corporation “Sika Repair 211 SC Plus”

D. Epoxy Injection:
1. ASTM C881, moisture insensitive maximum viscosity 350 cps at 77°F (25°C).
2. Acceptable Product: BASF “Concresive 1380”
3. Acceptable Product: Euclid Chemical Company “Eucopoxy Injection Resin”
4. Acceptable Product: Sika Corporation “Sikadur 35, LV, LPL”

E. Pressure-Injected Foam Resin:
1. Acceptable Product: DeNeef “HA Sealform”
2. Acceptable Product: 3M “ScotchSeal 5600”
3. Acceptable Product: Sika Corporation “SikaFix HH”

F. Semi Rigid Epoxy:
1. Acceptable Product: METZGER/McGUIRE “MM-80 Semi Rigid Epoxy Joint Filler”

G. Methyl Methacrylate (MMA)
1. Acceptable Product: Transpo Industries, Inc. “T-78 Methyl Methacrylate Polymer Crack Healer/Sealer”

H. Sealant:
1. Silicone or Polyurethane Sealant (as selected based on project requirements such as loading, traffic, bond, coatings, etc.).
2. Joint to be routed and cleaned per manufacturer’s written directions.

PART 3 - EXECUTION

3.1 PREPARATION

A. Subgrade:
1. Dampen subgrades not covered with membrane by sprinkling immediately before placing concrete.
a) Omit when subgrade is already damp.
2. Do not place on water-saturated subgrade unless placing can be done without damage to subgrade (surface is stable) and loading the subgrade does not drive free water to the surface.
3. Do not place concrete on frozen ground.

B. Forms:
1. Coordinate with Section 031000 Concrete Formwork.
2. Remove dirt, sawdust, nails and other foreign material from formed space.
3. Dampen wood forms by sprinkling immediately before placing.
4. Cool metal forms by sprinkling immediately before placing.

C. Concrete Accessories:
1. Coordinate with Section 031000 Concrete Formwork.

D. Dewatering:
1. Remove water from concrete formwork.
2. Divert any flowing water to sump and remove by pumping.
3. Refer to Division 1 for additional dewatering requirements.

E. Vapor Retarder Placement: See Division 7, Thermal and Moisture Protection.
1. Vapor retarder installation shall be in accordance with manufacturer’s instructions and ASTM E 1643.
2. Place vapor retarder under slabs-on-grade in position with longest dimension parallel with direction of pour.
3. Joints: Lap 6" (150mm) minimum and seal with manufacturer’s recommended mastic or pressure-sensitive tape.
4. Prevent damage to moisture barrier.

5. If moisture barrier is damaged, place a piece of moisture barrier over damaged area (6" (150mm) larger all around) and tape in place with type of tape recommended by moisture barrier manufacturer.
6. Seal laps and intersections of walls with compatible trowel mastic or pressure-sensitive sealing tape.
7. Seal around pipes and other penetrations with compatible trowel mastic.
8. The vapor barrier must be approved prior to concrete placement.

3.2 JOINTS IN CONCRETE

A. Locate construction and contraction joints as indicated on Drawings and on approved joint location submittal.
   1. Do not use contraction joints in framed floors or composite slabs.
   2. Locate and install construction joints so they do not impair strength or appearance of the structure, as acceptable to Design Professionals.
   3. Coordinate location of construction and contraction joints with locations of joints in finish materials where they exist.
      a) Construction and contraction joints in slabs or slab on grade with terrazzo finish must be reviewed and approved by the Design Professionals.
   4. Maximum joint spacing is as indicated on Drawings.

B. Construction Joints:
   1. Construction joints shall be located within the central third of the span. Any concrete spilling over or through the bulkhead shall be removed at the completion of the pour. All surfaces of the concrete shall have reinforcing extending through the joint.
   2. Horizontal Joints: Horizontal construction joints other than those shown on the Drawings will not be permitted unless approved by the Architect.
   3. Joint Preparation: Forms shall be removed in time to permit roughening of construction joints of structural members by chipping and wire brushing to remove all loose and foreign material and roughen to ¼" amplitude. The existing concrete at joints shall either be (a) dampened to the point that the surface is saturated, but all standing water has been removed, promptly followed by placement and vibration of fresh concrete, or (b) not required to be dampened, with one of the specified bonding compounds applied as appropriate for the joint condition, following manufacturer recommendations, with placement and vibration of fresh concrete to follow while the epoxy bonding agent is still tacky. Joints without epoxy bonding agent require fresh concrete with slump 7 inches (180mm) or greater at horizontal joints, and fresh concrete confined to maintain pressure against the joint at vertical joints. Where such conditions are not present, or where applying water to dampen the surface is impractical, use epoxy bonding agent suitable for dry surfaces

C. Isolation Joints:
   1. Interrupt structural continuity resulting from bond, reinforcement or keyway at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls and other locations, as indicated.

D. Contraction Joints in Floor Slabs-on-Grade:
   1. Maximum slab area controlled by jointing is 400 square feet (35 square meters).
   2. Space joints at 36 times slab thickness unless a smaller spacing is indicated on the Drawings, located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).
   3. Contraction joints can be provided by sawcuts, formed joints or appropriately detailed construction joints.
   4. Sawcuts shall be made as soon as possible after slab finishing as may be safely done without dislodging aggregate. The Soff-Cut saw shall be used to a depth of ¼ of slab thickness immediately after final finishing. Conventional saw shall be used as soon as possible after final finish without raveling to a depth as indicated on the Drawings.
   5. Where contraction joints coincide with construction joints, detail joint as indicated on Drawings.

E. Joint Fillers: Coordinate with Section 032000 Concrete Reinforcement and Embedded Assemblies and Division 7 requirements.

3.3 MIXING

A. Measurement of Materials: Conforming to ASTM C 94

B. Mixing: All concrete shall be ready-mixed conforming to ASTM C 94 except as follows:
   1. Provide concrete materials, proportions and properties as herein specified in lieu of ASTM C 94.
   2. Water, beyond that required by the mix design, shall not be added at the Project site. Addition of water at the Project site shall be made only in the presence of the Owner's Testing Agency.
   3. Furnish delivery ticket with each load of concrete delivered to the site to the Contractor conforming to the requirements of ASTM C 94.

C. High range water reducing agents (superplasticizer), if added at the batch plant, may be added again at the Project site.
   1. If superplasticizers are added at the batch plant, the concrete mix design must account for the delivery time, workability, finishability, and setting time required on the jobsite for proper placing and finishing procedures.
   2. If the superplasticizer is redosed at the jobsite in air entrained concrete, air content must be checked after mixing.

D. Discharge of the concrete shall be completed within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first, after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates.

3.4 CONCRETE PLACEMENT

A. Prior to Concrete Placement:
   1. Mechanical vibrators are required and must be available for placing concrete.
   2. Remove debris from space to be occupied with concrete.
   3. Notify Design Professionals and Owner’s Testing Agency 48 hours prior to starting concrete placement.
   4. Approved mix designs must be maintained on file in Contractor's Field Office.
   5. Reinforcement and accessories shall be in proper locations, clean, free of loose scale, dirt or other foreign coatings that may reduce bond to concrete, and in accordance with Section 032000 and Drawings.
   6. Fog spray forms, reinforcing steel, and subgrade just before pouring concrete.
   7. Do not place concrete having a slump outside of allowable slump range.
   8. Place concrete before initial set has occurred, but in no event after it has been discharged from the mixer more than 30 minutes. All concrete shall be placed upon clean, damp surfaces, free from puddled water, or upon properly consolidated fills. Placement upon soft mud or dry earth is not permitted.
   9. Unless adequate protection is provided, concrete shall not be placed during rain.
   10. Rain water shall not be allowed to increase mixing water or to damage the surface finish.
   11. At surfaces left exposed to view, do not use equipment in placing and finishing concrete that contain aluminum in the finishing edges that come in contact with the concrete surface.
   12. Keep subgrade moisture uniform without puddles or dry areas.
   13. Place vapor retarder directly below slabs on grade as specified in Contract Documents.

B. For Conduits and Pipes Embedded in Concrete:
   1. For concrete slab, wall, beam or column, conform to requirements of ACI 318, Chapter 6. For variations from these requirements, submit a written request for Design Professionals' review and response.
   2. Conduits and pipes shall not be embedded in concrete slabs on steel deck without approval of Design Professional.
   3. Provide sleeves for pipes passing vertically through concrete.
   4. Do not embed aluminum materials.
   5. Do not cut, bend or displace the reinforcement to facilitate placement of embedded pipes and conduits.

C. Pumping: Pumping shall be done in strict accordance with ACI 304.2R.

D. Placing Concrete in Forms:
   1. Clean and prepare forms as specified in Section 031000/Concrete Formwork.
   2. Place concrete continuously without interruption between predetermined construction and contraction joints in walls.
   3. Deposit concrete in forms in horizontal layers no deeper than 24” (600mm) and in a manner to avoid inclined construction joints.
   4. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
   5. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping.
      a) Use equipment and procedures for consolidation of concrete in accordance with ACI 309R.
   6. Do not use vibrators to move fresh concrete laterally inside forms from discharge point; shift discharge point as needed.
   7. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the machine.
   8. Place vibrators to rapidly penetrate placed layer and at least 6" (150mm) into preceding layer.
   9. Do not insert vibrators into lower layers of concrete that have begun to set.

10. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
11. Do not vibrate Self-Consolidating Concrete (SCC).

E. Placing Concrete Slabs:
1. Place concrete continuously without interruption between predetermined construction and contraction joints in floors.
   a) Place slabs on grade by the long strip cast method. Refer to ACI 302.1R for recommended methods of placement.
2. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until completing placement of a panel or section.
3. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement, other embedded items and into corners.
4. Bring slab surfaces to correct level with a straightedge and strike off.
   a) Use highway straight edges, bullfloats or darbies to smooth surface free of humps or hollows.
   b) Do not disturb slab surfaces prior to beginning finishing operations.
5. Maintain reinforcing in proper position on chairs during concrete placement.
6. Do not place materials on slabs or impose loads during period of setting.

F. Placing Concrete on Steel Decks
1. Exercise care during concrete placement on steel decks to prevent concentrated loads or high pile-ups of concrete and to avoid impacts caused by dumping or dropping of concrete on steel decks.
2. Do not use buggies on unprotected areas of deck. If buggies are used to place concrete, furnish and install planked runways to protect deck from damage.

G. Placing Concrete at Construction Joints:
1. To secure full bond at construction joints, surfaces to receive concrete in a subsequent placement shall be left in a roughened state or intentionally roughened by raking while plastic or brushing and chipping immediately after removal.
2. Before new concrete is placed in contact, surfaces of hardened concrete already placed shall be thoroughly cleaned of foreign materials and laitance.
3. At hardened concrete at joints where no bonding agents are used, dampen concrete to achieve a saturated surface dry condition. Leave no standing water. Place and vibrate concrete (slump 7 inches (180mm) or greater) against horizontal joints. Place and vibrate flowing concrete (slump 8 to 10 inches (200 to 250mm)) while maintaining pressure against vertical joints by confinement.
4. At hardened concrete with joints not meeting conditions required for no bonding agents, apply appropriate specified bonding agent for conditions present including age and moisture per manufacturer's specifications. Place new concrete while the bonding agent is still tacky.

H. Floor Topping Slabs:
1. Place concrete topping slab to required lines and levels.
2. Minimum topping slab thickness is 2" (50mm).
3. Place dividers, edge strips and other items to be cast in place.
4. At all topping slabs, remove deleterious material before placing topping slab.
5. At topping slabs placed directly against base slab, remove deleterious material and dampen base slab with water immediately before placing concrete. Leave no standing water.
6. Unless noted as a "bonded" topping slab on the Drawings, topping slabs thinner than 4" (100mm) should be placed directly against dampened base slab with no bonding agent. Topping slabs 4" (100mm) or thicker should be placed on bond breaker consisting of two sheets of plastic film.
7. Where noted on Drawings as a "bonded" topping slab, broom/vacuum clean unsealed surfaces or wire brush sealed or troweled surfaces to expose bare rough surface. Then place approved bonding grout or epoxy adhesive on the base slab per manufacturer's instructions.
8. The topping mix shall have a maximum water/cement ratio of 0.45.
9. The topping mix shall have a maximum shrinkage of 0.04% in 28 days.
10. The topping mix shall contain a minimum of 5 lbs. per cubic yard (2.43 kg/m3) of macro synthetic fibers and achieve an Average Residual Strength (ARS) of 200 psi (1.4MPa) unless a higher dosage or ARS is noted on the plans.
11. The topping slab shall be moist cured for a minimum of 36 hours after placement.
12. The topping slab shall have contraction joints located to match any joints in the base slab, to eliminate restraint conditions such as re-entrant corners and to isolate the slab from columns, walls, etc. and to limit the maximum distance between joints to 15 feet (4570mm).

I. Cold-Weather Placement:
1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306R and as specified in this section.

2. When air temperature has fallen to or is expected to fall below 40°F (4°C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50°F (10°C), and not more than 80°F (27°C), at point of placement.
3. Do not use frozen materials or materials containing ice or snow.
   a) Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
4. Remove frost, snow and ice from forms, reinforcement and other embedments immediately prior to concrete placement.
5. Use only the specified non-corrosive accelerating admixture previously approved as part of the cold weather mixture. Addition of calcium chloride, salt, thiocyanates or admixtures containing more than 0.05 percent chloride ions is not permitted.

J. Hot-Weather Placement:
1. Hot weather is defined as air temperature which exceeds 90°F (32°C) or any combination of high temperature, low humidity and/or high wind velocity which causes a rate of evaporation in excess of 0.2 pounds per square feet per hour (1.0 kg/m² per hour) as determined by ACI 305R.
2. When hot weather conditions exist that would impair quality and strength of concrete, place concrete in compliance with ACI 305R and as specified in this section.
3. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90°F (32°C).
4. Mixing water may be chilled, or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
5. Use of liquid nitrogen to cool concrete is Contractor's option.
6. When concrete placement will occur late in the day and reinforcing steel will be heated by the sun, cover reinforcing steel with water-soaked burlap so that steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
7. When concrete operations must be performed in direct sun, wind, high temperatures, low relative humidity, or other adverse placing conditions, the specified evaporation retarder shall be applied one or more times during the finishing operation to prevent plastic cracking.
   3.5 DAYS.]

3.6 CONCRETE FINISHES

A. General:
1. Comply with recommendations for concrete finishing established by ACI 302.1R and ACI 304R.
2. Comply with dimensional tolerance limitations given by ACI 117.
3. For shored floor or slab on grade construction: Floor flatness/floor levelness tolerance compliance testing is to be performed prior to the removal of shores and forms but not later than 72 hours of concrete placement by Owner's Testing Agency.
4. See architectural Drawings for locations of the various finishes listed below.
5. Comply with the specified overall SOF_F and SOF_L values listed below:

a) The specified overall area shall be each individual floor.
b) F_F/F_L shall be measured in accordance with ASTM E 1155.
c) The specified minimum local values of MLF_F/MLF_L shall be 3/5 of the SOF_F/SOF_L values listed below.
d) If an individual test section measures less than either of the specified minimum local MLF_F/ MLF_L numbers, that section may be rejected and remedial measures may be required as specified in CONCRETE SURFACE REPAIRS.
e) If the composite value of the test surface measures less than either of the specified overall SOF_F/SOF_L numbers, then the entire slab may be rejected and remedial measures may be required.
f) F_L numbers shall not apply to unshored slabs or shored slabs with camber.

B. Finish for monolithic slab surfaces to receive concrete floor topping or mortar setting beds for tile and other bonded applied cementitious finish flooring material, as indicated on architectural Drawings:
1. Scratch Finish.
   a) Finish surface to overall value of SOF_F=20 and SOF_L=15.
   b) Slope surfaces uniformly to drains where required.
   c) After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.

C. Finish for monolithic slab surfaces to be covered with membrane or elastic waterproofing, membrane or elastic roofing, sand-bed terrazzo as indicated on architectural Drawings:
1. Float Finish.
   a) After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating.
   b) Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both.

c) Consolidate surface with power-driven floats or by hand-floating if area is small or inaccessible to power units.
d) Finish surfaces to overall value of SOF_F=20 and SOF_L=15.
e) Cut down high spots and fill low spots.
f) Uniformly slope surfaces to drains.
g) Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

D. Finishes for Pedestrian Sidewalks and Ramps, Exterior Platforms, Steps, as indicated on architectural Drawings:
1. Sidewalks and Curbs: Light-to-medium broom finish applied with fiber-bristle broom perpendicular to direction of main traffic route immediately after float finishing.
2. Ramps: Scored finish as applied perpendicular to direction of main traffic route immediately after float finishing.
3. Finish surface to overall value of SOF_F=20 and SOF_L=15.
4. Texture shall be approved by the Design Professionals from sample panels.

E. Finish for interior floor slab surfaces exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile on thick-set mortar, paint or another thin film-finish coating system, as indicated on architectural Drawings:
1. Trowel Finish.
a) After floating, begin first trowel-finish operation using a power-driven trowel.
b) Begin final troweling when surface produces a ringing sound as trowel is moved over surface.
c) The final hand-troweling operation shall result in a smooth surface, free of trowel marks, uniform in texture and appearance.
d) Grind smooth any surface defects that would telegraph through applied floor covering system.
2. Finish surface to overall value of SOF_F=25 and SOF_L=20.
3. Floor Slopes: Where drains occur, slope floor slabs uniformly to drains, maintaining scheduled slab thickness.
4. Floor Edges at Expansion Joints: Tool edges minimum 3/8" (10mm).
5. Defects: Remove defects of sufficient magnitude to show through floor covering by grinding.
6. Floor Hardener: Use only where scheduled and in accordance with manufacturer's published instructions.
7. Dry Cement: Shall not be used during finishing.

F. Finish for thin set ceramic tile or thin set epoxy terrazzo, as indicated on architectural Drawings:
1. Trowel and Fine Broom Finish:
a) Apply a trowel finish as specified.
b) Immediately follow by slightly scarifying the surface with a fine broom.
2. Finish surface to overall value of SOF_F=35 and SOF_L=25.

G. Finishes for Parking Garage Deck, Ramps, Loading Docks:
1. Highway straight edge immediately after screeding concrete.
2. Finish surface to overall values of SOF_F=20 and SOF_L=15.
3. For Slabs Not Receiving Deck Coating: Medium broom finish with ridges not to exceed 1/8" (3mm) in height. Texture shall be as approved by the Design Professionals from sample panels.
4. For Slabs Scheduled to Receive Deck Coating: Smooth floated finish which must be verified with coating manufacturer before finishing the slab.
a) Coordinate with deck coating specified in Division 7.
5. Auto Ramps: Rough texture applied perpendicular to direction of traffic. Texture shall be as approved by the Design Professionals from sample panels.

H. Tolerances at Slab Discontinuities
1. Within 2 ft (600mm) of slab boundaries, construction joints, isolation joints, block-outs, penetrations or other similar discontinuities, where required for travel paths, installation of finishes and partitions, or any other requirements indicated in the Contract Documents, the following equivalent straightedge tolerances shall apply:
a) Specified local MLF_F = 12, use ¼” (6mm) over 4 ft (1200mm), no offset greater than 1/16” (2mm)
b) Specified local MLF_F = 15, use 1/8” (3mm) over 4 ft (1200mm), no offset greater than 1/32” (0.8mm)

I. Dry Shake Finish:
1. Non-slip aggregate where indicated on Drawings.
2. Non-oxidizing metallic hardener on loading docks at a rate of 1.5 lbs. per sq. ft. (7.3 kg/m²) and in other locations so noted on the Drawings.

3. Mineral aggregate hardener at a rate of 1.2 lbs. per sq. ft. (5.8 kg/m²) where noted on the Drawings.
4. Final finish type, method and tolerance as applicable by location and use.
5. Dry shake finish will be applied only where scheduled and in accordance with the manufacturer's published instructions and the methods and procedures agreed upon at the pre-installation conference.

J. Rough Formed Finish:
1. Acceptable for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated.
2. Concrete surface shall have texture imparted by form-facing material used, with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4" (6mm) in height rubber down or chipped off.

K. Smooth Formed Finish:
1. Required for formed concrete surfaces exposed to view, or scheduled to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system, as indicated on architectural Drawings:
2. Surface is an as-cast concrete surface obtained with selected form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
3. Repair and patch tie holes and defects. Remove fins and other projections completely.

L. Smooth Rubbed Finish:
1. "Smooth Rubbed" finish shall consist of a finish free of fins, joint marks smoothed off, blemishes removed and surfaces left smooth and unmarred.
2. Provide smooth rubbed finish to scheduled concrete surfaces, as indicated on architectural Drawings, which have received smooth form finish treatment not later than one day after form removal.
3. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced.
   a) Do not apply cement grout other than that created by the rubbing process.

M. Grout-Cleaned Finish:
1. Provide grout-cleaned finish on scheduled concrete surfaces, as indicated on architectural Drawings, that have received smooth-formed finish treatment.
2. Combine one part Portland Cement to one and one-half parts fine sand by volume, and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint.
3. Blend standard Portland Cement and white Portland Cement in amounts determined by trial patches so that final color of dry grout will match adjacent surfaces.
4. Thoroughly wet concrete surfaces, apply grout to coat surfaces, and fill small holes.
5. Remove excess grout by scraping and rubbing with clean burlap.
6. Keep surface damp by fog spray for at least 36 hours after rubbing.

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

3.7 CURING AND PROTECTION

A. Normal Conditions:
1. Protect concrete from premature drying, excessive hot or cold temperature, and damage.
2. Concrete shall be kept continuously moist and above 50°F (10°C) for seven days (ASTM C 150 Type I cement) or for 10 days (ASTM C 150 Type II cement). High early strength concrete usage shall be maintained over 50o F (10°C) for three days.
3. Concrete and concrete patching materials shall be cured according to manufacturers published recommendations.
4. Begin curing as soon as free water has disappeared from concrete surface and finishing has been completed.
5. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining cover curing, or by combining these methods, as specified.
   a) Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:
      i. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared).

ii. Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions.
iii. Recoat areas subjected to heavy rainfall within 3 hours after initial application.
iv. Maintain continuity of coating and repair damage during curing period.
v. Use curing and sealing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.
vi. Floors to receive covering shall be cleaned thoroughly using a power scrubber and industrial strength detergent.
Hand-brooming and sweeping is not sufficient.
vii. Strippable curing compound may be used in lieu of a moist curing method when approved by the Design Professionals.

b) Provide moist curing by the following methods:
i. Keep concrete surface continuously wet by covering with water.
ii. Use continuous water-fog spray.
iii. 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 a 4” (100mm) lap over adjacent absorptive covers.

c) Provide moisture-retaining cover curing as follows:
i. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3” (75mm) and sealed by waterproof tape or adhesive.
(1) Immediately repair any holes or tears during curing period using cover material and waterproof tape

6. Cure slabs on grade, concrete toppings, concrete pour strips, supported slabs, walls and columns, not subject to conditions of hot or cold weather concreting, in accordance with ACI 308.
7. Cure surfaces exposed to deicing salts, brackish water, etc., such as loading dock slabs, parking garage slabs and ramps in accordance with ACI 308 recommendations for moist curing.
8. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by leaving forms in place for the full curing period (equivalent to moist curing).

a) If forms are removed prior to completion of full curing period, continue curing by methods specified above for Unformed Surfaces, as applicable.

B. Cold-Weather Protection:
1. When concrete is placed under conditions of cold weather concreting (defined as a period when the mean daily temperature drops below 40°F (4°C) for more than 3 successive days), take additional precautions as specified in ACI 306R when placing, curing, monitoring and protecting the fresh concrete.

C. Hot-Weather Protection:
1. When concrete is placed under conditions of hot weather concreting, provide extra protection of the concrete against excessive placement temperatures and excessive drying throughout the placing and curing operations with an evaporation retarder.
a) Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and troweling.
2. Hot weather curing is required if hot weather conditions occur within a 24-hour period after completion of concrete placement.

D. Floor surfaces, wherever indicated by weather conditions, shall be sprinkled during the interval between finishing operation and the start of curing to positively ensure against the possibility of surface drying.

3.8 CONCRETE REPAIRS

A. Perform patching and repairs in accordance with ACI 301.
B. Contractor shall submit patching and repair methods and materials for review by Design Professionals.
C. When complete, all patches and repairs shall match color and texture of adjoining surfaces.
D. At surfaces that are exposed to view, prepare test areas at inconspicuous locations for review by Design Professionals to verify repair color and texture match before proceeding with repair.
E. Apply all patching and repair materials in accordance with manufacturer’s specifications.
F. Repairing Cracks In Formed and Unformed Surfaces:
1. Contractor shall notify Design Professionals of all cracks wider than 0.02” (0.50mm) and all cracks wider than 0.01” (0.25mm) that occur in a group of at least three cracks within twelve inches (300mm), in concrete. If Design Professionals deem repairs necessary, Contractor shall be responsible for repairing all such cracks per Design Professionals recommendation at no expense to the Owner. Repairs will generally require one or more of the following: Epoxy Injection, Semi-

Rigid Epoxy, Pressure Injected Foam Resin, Methyl Methacrylate and/or Sealant with joint routed and cleaned. See Concrete Repair Materials section of this Specification for acceptable products

G. Repairing Formed Surfaces
1. Immediately after stripping forms, patch all honeycombing, defective joints, voids, etc. before the concrete is thoroughly dry.
2. Remove all burrs, fins, and ridges before the concrete is thoroughly dry.
3. Remove stains from rust, grease and oils, from release agents, etc.
4. Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of the Design Professionals.
   a) Surface defects, include color and texture irregularities, cracks as defined above, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
   b) Chip away defective areas, honeycomb, rock pockets, voids over 1/4" (6mm) in any dimension and holes left by tie rods and bolts, down to solid concrete but in no case to a depth less than 1" (25mm) and saw-cut edges to prevent feather edging of fill material.
5. Repair concealed formed surfaces, where possible, containing defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
6. Clean out form tie holes and fill with dry pack mortar or precast cone plugs secured in place with bonding agent.
7. If honeycombing exposes reinforcement, chip to provide clear space at least 3/4" (20mm) wide all around steel to allow proper bond.

H. Repairing Unformed Surfaces:
1. High and Low areas in concrete surfaces which are in excess of specified tolerances shall be leveled or ground-smooth.
   a) Correct high areas by grinding after concrete has cured at least 14 days.
   b) Correct low areas by applying leveling material. Finish leveling material as specified in this section.
2. Repair surfaces containing defects that affect durability of concrete.
   a) Surface defects include crazing, cracks as defined above, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
3. Repair defective areas, except random cracks and single holes not exceeding 1" (25mm) in diameter, by cutting out and replacing with fresh concrete.
   a) Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4" (20mm) clearance all around.

I. Filling In: Fill in holes and openings left in concrete for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place.

3.9 EVALUATION AND ACCEPTANCE OF CONCRETE

A. In accordance with ACI 301, except where otherwise specified.

B. If, at any time during construction, the concrete resulting from the approved mix design deviates from Specification requirements for any reason, such as lack of workability, or insufficient strength, the Contractor shall have his laboratory verify the deficiency and modify the mix design, until the specified concrete is obtained. Modified mix to be submitted for approval per Part 1 - SUBMITTALS.

3.10 CORRECTIVE MEASURES

A. Conflicts: The Contractor shall be solely responsible for errors of detailing, fabrication, and placement of reinforcement steel; placement of inserts and other embedded items; and the structural adequacy of all formwork.

B. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated by failure of the Contractor to perform the work in accordance with the Contract Documents either developing corrective actions or reviewing corrective actions developed by others, the Contractor is responsible for paying for additional work performed by the Design Professionals at their standard firm-wide billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

Balance of page blank; see form on next page

CONCRETE MIX DESIGN SUBMITTAL FORM

Project: _____

City: _____

General Contractor: _____

Concrete Contractor: _____

Concrete Strength: _____

Use/Location on Job: _____

Supplier's Mix Designation: _____

Design Mix Information **(Please check one):** *Refer to ACI 301 for requirements of data used to substantiate strength calculations.*

Field Experience (Based on Standard Deviation Analysis): _____

Trial Mixture Test Data: _____

Design Characteristics:

Density: _____ Pcf (kg/m3)

Strength: _____ Psi (MPa) (28 day)

Air: _____ % (specified)

Materials:	Type/Source	Specific Gravity	Weight (lb)	Absolute Vol. (cu. ft.) (cu. m)
Cement:				
Fly ash:				
Slag (GGBFS)				
Microsilica:				
Coarse Aggregate:				
Fine Aggregate:				
Water:				
Air:				
Other:				
TOTAL:				27.0 cu. ft. (1.0 m3)
Water/Cementitious Material Ratio (lbs. (kg) water / lbs. (kg) cementitious material) =				%

Admixtures:	Manufacturer	ASTM	Dosage (oz/cwt)
Water Reducer:			
Air Entraining Agent:			
High Range Water Reducer			
Non-corrosive Accelerator:			
Other:			

Slump before HRWR: _____ Inches (mm)

Slump after HRWR: _____ Inches (mm)

Standard Deviation Analysis (from experience records):

No. of Test Cylinders Evaluated: _____

Standard Deviation: _____

Required Average Strength f'cr

Average Strength by Tests

Equation Used (ACI Chapter 5)

(Refer to ACI 318 for increased deviation factor when less than 30 tests are available)

TRIAL MIXTURE TEST DATA

Compressive Strength:	Age (days)	Mix #1	Mix #2	Mix #3
	28	psi (MPa)	psi (MPa)	psi (MPa)
	28	psi (MPa)	psi (MPa)	psi (MPa)
	28	psi (MPa)	psi (MPa)	psi (MPa)
	Average	psi (MPa)	psi (MPa)	psi (MPa)
Required Average Strength f'cr				
Average Strength by Tests				
Equation Used (ACI Chapter 5)				

REQUIRED ATTACHMENTS	***Please check***
Coarse Aggregate Gradation Report	
Fine Aggregate Gradation Report	
Fly Ash (or other Supplementary Cementitious Material) Certification	
Concrete Compressive Strength Data or Trial Mixture Test Data	
Admixture Compatibility certification letters	
Chloride Ion Content Certification	
Alkali Aggregate Reactivity Certification	
Shrinkage Test Reports	

SUBMITTED BY:

Name: _____

Address: _____

_____

Phone no.: _____

Main Plant Location: _____

Miles from Project: _____

Secondary Plant Location: _____

Miles from Project: _____

_____

Date: _____

Certification by Concrete Supplier:
Signature: _____

Print Name: _____

PE License Number and Expiration Date (print or stamp) _____

Structural Substitution Request Form – to be completed by Contractor

Project:		
Date:		Substitution Request #
Requesting Contractor:		Pages Attached (including this form)

1. Description of Requested Substitution:

2. Related Drawings and Specification Sections:

3. Rationale or Benefit Anticipated:

4. Effect on Construction Schedule[1] (check one): ☐ NONE ☐ See Attached

5. Effect on Owner's Cost[2] attach data (check one): ☐ CREDIT TO OWNER ☐ EXTRA

6. Effect on Construction Documents[3] (design work anticipated): ☐ NONE ☐ See Attached

7. Requesting Contractor Agrees to Pay for Design Changes (check): ☐ YES ☐ NO ☐ NOT APPLICABLE

8. Effect on Other Trades[4]:

9. Effect of Substitution on Manufacturer's Warranty (check): ☐ NONE ☐ See Attachment

Signature[5]: Date:

Company:

General Contractor Signature[5]: Date:

Notes:

1. Contractor is responsible for means and methods and any problems that may arise from making the requested substitution.
2. This is **NOT A CHANGE ORDER FORM**. A separate form is required to adjust costs and/or schedules.
3. Contractor is responsible for any design impacts that may arise from this substitution, including redesign efforts.
4. Contractor is responsible for effects on other trades from this substitution; General Contractor must review and agree effects on other trades are fairly represented in items 4-9.
5. Signature by a person having authority to legally bind his/her company to the above terms. Otherwise this request is void
6. All items in form must be completed for substitution request to be considered.

Request Review Responses (completed by Architect and/or Engineer(s)):

ACCEPTED	ACCEPTED AS NOTED	REJECTED	INSUFFICIENT DATA TO SUPPORT REQUEST	ENGINEER / ARCH / MEP SIGNATURE	DATE

Engineer/Architect Comments:

EXAMPLE CONCRETE STRENGTH SPREADSHEET LOG

PROJECT:
DATE:
ARCHITECT:
STRUCTURAL ENGINEER:

SPECIMEN I.D.	TICKET NUMBER	PLACEMENT LOCATION	MIX I.D.	CURE TYPE*	DATE TESTED	AGE AT TEST (DAYS)	AVERAGE DIAMETER (IN)	AVERAGE CROSS-SECTIONAL AREA (IN^2)	BREAKING LOAD (LB)	BREAK TYPE **	AVERAGE COMPRESSIVE STRENGTH (PSI)
S0002	1234	First Floor Slabs and Beams	H3651	I, CA, CB	3/8/2106	7	4	12.56	165990	Type 1	13210
						14					
						28					
						56					

*FIELD CURING CONDITIONS: NCB=NO CURING BOX, CB=CURING BOX, I=INSULATED, CO=COOLED, HE=HEATED, CA=CAPPED, IC=ICED, O=OTHER

**BREAK TYPES (AS CLASSIFIED BY ASTM C39):

END OF SECTION 033000

SECTION 033713 - SHOTCRETE

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. Shotcrete for playground rubber mounds.

1.3 DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

A. Shotcrete: Mortar or concrete pneumatically projected onto a surface at high velocity.

B. Dry-Mix Shotcrete: Shotcrete with most of the mixing water added at nozzle.

C. Wet-Mix Shotcrete: Shotcrete with ingredients, including mixing water, mixed before introduction into delivery hose.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include reinforcement and forming accessories, shotcrete materials, admixtures, and curing compounds.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

2. Product Certificates: For materials manufactured within 500 miles of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.

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

1. Indicate which method (dry-mix or wet-mix) will be used for installation."
2. For predampened dry-mix mixtures, indicate amounts of mixing water to be added to the dry-mix materials before mixing and conveying through the delivery hose.

D. Shop Drawings: For shotcrete installation.

1. Include plans, elevations, sections, and support and anchor details.
2. Detail fabrication, bending, and placing of reinforcement; number and location of splices; and special reinforcement required for openings through shotcrete structures.
3. Detail formwork fabrication, assembly, and support.
4. Indicate locations of proposed construction joints.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Form materials.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Waterstops.
7. Curing compounds.

C. Preconstruction Test Reports: For shotcrete.

D. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer employing nozzle operators for Project, each of whom attains mean core grades not exceeding 2.5, according to ACI 506.2, on preconstruction tests, is ACI Shotcrete Nozzleman certified in Dry-Mix Process for Vertical Position, and is ACI Shotcrete Nozzleman certified in Wet-Mix Process for Vertical Position as appropriate to the required shotcrete work.

B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

C. Standard: Comply with ACI 506.2, "Specification for Shotcrete," unless otherwise indicated.

D. Shotcrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design shotcrete mixtures.

E. 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 finish required and for each design mixture, shooting orientation, and nozzle operator.
2. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
3. Demonstrate curing and protecting of shotcrete, finishes, and joints, as applicable.
4. In presence of Architect, damage part of the exposed-face surface for each color and finish, and demonstrate materials and techniques proposed for repair of holes and surface blemishes to match adjacent undamaged surfaces.
5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. 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: Engage a qualified testing agency to perform preconstruction testing on shotcrete.

Revise test-panel size and thickness in first subparagraph below to suit Project.

1. Produce and test shotcrete test panels before shotcrete placement according to requirements in ACI 506.2 for each design mixture, shooting orientation, and nozzle operator. Produce test panels with dimensions of 24 by 24 inches minimum and of average thickness of shotcrete, but not less than 3-1/2 inches.
2. From each test panel, testing agency shall obtain six test specimens: one set of three specimens unreinforced, and one set of three specimens reinforced. Agency will perform the following:
    a. Strength Testing: Test each set of unreinforced specimens for compressive strength according to ASTM C42/C42M.
    b. Core Grading: Visually inspect each set of reinforced shotcrete cores taken from test panels and determine mean core grades according to ACI 506.2.

1.9 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms: Form-facing panels that will provide continuous, straight, smooth, concrete surfaces. Furnish panels in largest practical sizes to minimize number of joints.

2.2 REINFORCING MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent." Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Plain-Steel Wire: ASTM A1064/A1064M as drawn.

C. Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place; manufactured according to CRSI's "Manual of Standard Practice" and as follows:

1. For uncoated reinforcement, use all-plastic, CRSI Class 1, plastic-protected or CRSI Class 2, stainless-steel bar supports.

D. Reinforcing Anchors: ASTM A36/A36M, unheaded rods or ASTM A307, Grade A, hex-head bolts; carbon steel; and carbon-steel nuts.

1. Finish: Plain, uncoated.

2.3 SHOTCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 500 miles of Project site from aggregates that have been extracted, harvested, or recovered, as well as manufactured, within 50 miles of Project site and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site."

B. Portland Cement: ASTM C150/C150M, Type I or Type III. Use only one brand and type of cement for Project.

1. Fly Ash: ASTM C618, Class C or Class F.
2. Slag Cement: ASTM C989/C989M, Grade 100 or Grade 120.
3. Silica Fume: ASTM C1240, amorphous silica.

C. Normal-Weight Aggregates: ASTM C33/C33M, from a single source, and as follows:

1. Combined Aggregate Size: ACI 506R or ASTM C1436, Grading No. 1 or No. 2 sieve analysis.
2. Deleterious Substances: As specified for fine aggregate or coarse-aggregate Class 1N according to ASTM C33/C33M.

D. Water: Potable, complying with ASTM C94/C94M, and free from deleterious materials that may affect color stability, setting, or strength of shotcrete.

E. Admixtures: ASTM C1141/C1141M, Class A (liquid) or Class B (nonliquid), but limited to the following admixture materials. Provide admixtures for shotcrete that contain no more than 0.1 percent chloride ions. Certify compatibility of admixtures with each other and with other cementitious materials.

1. Accelerating Admixture, Conventional: ASTM C494/C494M, Type C or Type E.

2. Pozzolanic Admixture: Fly ash, slag cement, and silica fume as limited in "Portland Cement" Paragraph in this article.
3. Air-Entraining Admixture: As limited in "Shotcrete Mixtures" Article.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry, or cotton mats.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Curing Compound: ASTM C309, Type 1, Class B; clear, waterborne, membrane-forming curing compound.

2.5 SHOTCRETE MIXTURES

A. Source Limitations for Shotcrete: Obtain each color, size, type, and variety of shotcrete material and shotcrete mixture from single manufacturer with resources to provide shotcrete of consistent quality in appearance and physical properties.

B. Design Mixtures: Prepare design mixtures for each type and strength of shotcrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 506.2.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixture or field test data, or both.

C. Cementitious Materials, Maximum Content: Limit use of fly ash, slag cement, and silica fume to not exceed, in combination, 25 percent of portland cement by weight.

D. Limit water-soluble chloride ions to maximum percentage by weight of cement or cementitious materials permitted by ACI 301.

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

F. Design-Mixture Adjustments: Subject to compliance with requirements, shotcrete design-mixture adjustments may be proposed when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

G. Shotcrete Mixture: Proportion mixture to provide shotcrete with the following properties:

1. Compressive Strength (28 Days): 3000 psi.
2. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight wet-mix shotcrete having an air content before pumping of 7 percent with a tolerance of plus or minus 1-1/2 percent.
3. Color: Natural gray.

2.6 SHOTCRETE EQUIPMENT

A. Mixing Equipment: Capable of thoroughly mixing shotcrete materials in sufficient quantities to maintain continuous placement.

B. Dry-Mix Delivery Equipment: Capable of discharging aggregate-cement mixture into delivery hose under close control and maintaining continuous stream of uniformly mixed materials at required velocity to discharge nozzle. Equip discharge nozzle with manually operated water-injection system for directing even distribution of water to aggregate-cement mixture.

1. Provide uniform, steady supply of clean, compressed air to maintain constant nozzle velocity while simultaneously operating blow pipe for cleaning away rebound.
2. Provide water supply with uniform pressure at discharge nozzle to ensure uniform mixing with aggregate-cement mix. Provide water pump to system if line water pressure is inadequate.

C. Wet-Mix Delivery Equipment: Capable of discharging aggregate-cement-water mixture accurately, uniformly, and continuously.

2.7 BATCHING AND MIXING

A. Dry-Mix Process: Measure mixture proportions by weight batching according to ASTM C94/C94M or by volume batching complying with ASTM C685/C685M requirements.

1. In volume batching, adjust fine-aggregate volume for bulking. Test fine-aggregate moisture content at least once daily to determine extent of bulking.
2. Prepackaged shotcrete materials may be used at Contractor's option. Predampen prepackaged shotcrete materials and mix before use.

B. Wet-Mix Process: Measure, batch, mix, and deliver shotcrete according to ASTM C94/C94M and ASTM C1116/C1116M and furnish batch ticket information.

1. Comply with ASTM C685/C685M when shotcrete ingredients are delivered dry and proportioned and mixed on-site.

PART 3 - EXECUTION

3.1 PREPARATION

A. Concrete and Masonry Substrates: Before applying shotcrete, remove unsound or loose materials and contaminants that may inhibit shotcrete bonding. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders. Dampen surfaces to saturated, surface-dry condition before shotcreting.

1. Abrasive blast or hydroblast existing surfaces that do not require chipping to remove paint, oil, grease, or other contaminants and to provide roughened surface for proper shotcrete bonding.

B. Earth Substrates: Compact and trim to line and grade before placing shotcrete. Do not place shotcrete on frozen surfaces. Dampen surfaces to saturated, surface-dry condition before shotcreting.

C. Steel Substrates: Clean steel surfaces by abrasive blasting according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

3.2 STEEL REINFORCEMENT

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials that weaken shotcrete bonding.

C. Securely embed reinforcing anchors into existing substrates, located as required.

D. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports, bolsters, chairs, spacers, and other devices as required to maintain minimum concrete cover.

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

3.3 APPLICATION

A. Apply shotcrete applied by dry-mix or wet-mix process and according to ACI 506.2.

B. Apply temporary protective coverings and protect adjacent surfaces against deposit of rebound and overspray or impact from nozzle stream.

C. Moisten wood forms immediately before placing shotcrete where form coatings are not used.

D. Apply dry-mix shotcrete materials within 45 minutes after predampening and wet-mix shotcrete materials within 90 minutes after batching.

E. Deposit shotcrete continuously in multiple passes, to required thickness, without cold joints and laminations developing. Place shotcrete with nozzle held perpendicular to receiving surface. Begin shotcreting in corners and recesses.

1. Remove and dispose of rebound and overspray materials during shotcreting to maintain clean surfaces and to prevent rebound entrapment.
2. Remove and dispose of cuttings during the trimming or rodding process to prevent unconsolidated material from falling onto lower reinforcement.

F. Maintain reinforcement in position during shotcreting. Place shotcrete to completely encase reinforcement and other embedded items. Maintain steel reinforcement free of overspray, and prevent buildup against front face during shotcreting.

G. Do not place subsequent lifts until previous lift of shotcrete is capable of supporting new shotcrete.

H. Do not permit shotcrete to sag, slough, or dislodge.

I. Remove hardened overspray, rebound, and laitance from shotcrete surfaces to receive additional layers of shotcrete; dampen surfaces before shotcreting.

J. Do not disturb shotcrete surfaces before beginning finishing operations.

K. Remove ground wires or other alignment-control devices after shotcrete placement.

L. Shotcrete Core Grade: Apply shotcrete to achieve mean core grades not exceeding 2.5 according to ACI 506.2, with no single core grade exceeding 3.0.

M. Installation Tolerances: Place shotcrete without exceeding installation tolerances permitted by ACI 117, increased by a factor of two.

N. Cold-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 306.1 and as follows. Protect shotcrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. Discontinue shotcreting when ambient temperature is 40 deg F and falling.
2. Uniformly heat water and aggregates before mixing to obtain a shotcrete shooting temperature of not less than 50 deg F and no more than 90 deg F.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place shotcrete on frozen surfaces or surfaces containing frozen materials.
5. Do not use calcium chloride, salt, or other materials containing antifreeze agents.

O. Hot-Weather Shotcreting: Mix, place, and protect shotcrete according to ACI 305.1 when hot-weather conditions and high temperatures would seriously impair quality and strength of shotcrete, and as follows:

1. Cool ingredients before mixing to maintain, at time of placement, shotcrete temperature below 100 deg F for dry mix and 90 deg F for wet mix.
2. Reduce temperature of reinforcing steel and receiving surfaces below 100 deg F before shotcreting.

3.4 SURFACE FINISHES

A. General: Finish shotcrete according to descriptions in ACI 506R.

B. Natural Finishes:

1. Gun Finish: (Dry-Mix) Natural undisturbed finish as sprayed.
2. Broom Finish: (Wet-Mix) Rough-textured finish obtained by screeding or cutting exposed face of shotcrete to plane with cutting rod, edge of trowel, or straightedge after initial set; followed by uniform brooming.

3.5 CURING

A. Protect freshly placed shotcrete from premature drying and excessive cold or hot temperatures.

B. Begin curing immediately after placing and finishing but not before free water, if any, has disappeared from shotcrete surface.

C. Curing Exposed Surfaces: Cure shotcrete by one of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Water-saturated absorptive covers or moisture-retaining covers. Lap and seal sides and ends of covers with 12-inch lap over adjacent covers.
2. Curing Compound: Apply uniformly in continuous operation by power spray 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 curing compound to natural gun and flash-coat finishes at rate of 1 gal./100 sq. ft..

D. Curing Formed Surfaces: Cure formed shotcrete surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Air Content: ASTM C173/C173M, volumetric method or ASTM C231/C231M, pressure method; one test for each compressive-strength test for each mixture of air-entrained, wet-mix shotcrete measured before pumping.

C. Shotcrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.

D. In-Place Shotcrete Testing: One set of three unreinforced cores for each mixture and for each workday or for every 50 cu. yd. of shotcrete placed, whichever is less. Test cores for compressive strength according to ACI 506.2 and ASTM C42/C42M. Do not cut steel reinforcement.

E. Strength of shotcrete will be considered satisfactory according to the following:

1. Specimen Cores: Mean compressive strength of each set of three unreinforced cores equals or exceeds 85 percent of specified compressive strength, with no individual core less than 75 percent of specified compressive strength.
2. Specimen Cubes: Mean compressive strength of each set of three unreinforced cubes shall equal or exceed design compressive strength with no individual cube less than 88 percent of specified compressive strength.

F. Shotcrete will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.7 REPAIRS

A. Remove and replace shotcrete that is delaminated or exhibits laminations, voids, or sand/rock pockets exceeding limits for specified core grade of shotcrete.

1. Remove unsound or loose materials and contaminants that may inhibit bond of shotcrete repairs.
2. Chip or scarify areas to be repaired to extent necessary to provide sound substrate. Cut edges square and 1/2 inch deep at perimeter of work, tapering remaining shoulder at 1:1 slope into cavity to eliminate square shoulders.
3. Dampen surfaces and apply new shotcrete. Match adjacent color and finish.

B. Repair core holes from in-place testing according to repair provisions in ACI 301, except do not use shotcrete. Match adjacent color and finish.

3.8 CLEANING

A. Immediately remove and dispose of rebound and overspray materials from final shotcrete surfaces and areas not intended for shotcrete placement.

END OF SECTION 033713

SECTION 042223

ARCHITECTURAL CONCRETE UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Concrete Block.
B. Mortar.
C. Reinforcement and anchorage.
D. Flashings.
E. Lintels.
F. Accessories.

1.2 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2016.
C. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2016a.
D. ASTM C91/C91M - Standard Specification for Masonry Cement; 2012.
E. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units; 2017.
F. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2017a.
G. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2011.
H. ASTM C150/C150M - Standard Specification for Portland Cement; 2017.
I. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
J. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2014a.
K. ASTM C476 - Standard Specification for Grout for Masonry; 2016.
L. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2017.
M. ASTM C1072 - Standard Test Method for Measurement of Masonry Flexural Bond Strength; 2013, with Editorial Revision (2014).
N. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2014).
O. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2016.
P. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2016.
Q. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2014a.
R. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2016.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.
B. Mockups:
    1. Construct in-place mockup of 8x16x16 unit masonry for a 48” width by 72” height in region where 8”W x 8”H x 16”L unit masonry is to be located as indicated on drawings.

1.4 SUBMITTALS

A. See Section 013000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for masonry units, mortar, and masonry accessories.
C. Samples: Submit four samples of concrete unit masonry units to illustrate color, texture, and extremes of color range.
D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
F. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 016000 - Product Requirements, for additional provisions.

1.5 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of the contract documents.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size:
      a. Standard units with nominal face dimensions of 16 inches nominal length by 8 inches nominal height and nominal depth of 4 inches, where noted. To include Type 1 finish, as scheduled.
      b. Standard units with nominal face dimensions of 16 inches nominal length by 4 inches nominal height and nominal depth of 4 inches, where noted. To include Type 2 finish, as scheduled.
      c. Standard units with nominal face dimensions of 16 inches nominal length by 8 inches nominal height and nominal depth of 6 inches, where noted. To include Type 1 finish, as scheduled.
      d. Standard units with nominal face dimensions of 16 inches nominal length by 8 inches nominal height and nominal depth of 8 inches, where noted. To include Type 1 finish, as scheduled.
      e. Standard units with nominal face dimensions of 16 inches nominal length by 4 inches nominal height and nominal depth of 8 inches, where noted. To include Type 2 finish, as scheduled.
   2. Decorative CMU:
      a. Decorative Pattern: Specialized burnished block.
   3. Manufacturers
      a. Basis of Design: York Building Products, Temple Stone: www.yorkbuilding.com
      b. Substitutions: Prior approved equal.
   4. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
      a. Performance of Units with Integral Water Repellent:
         1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
            (a) No water visible on back of wall above flashing at the end of 24 hours.
            (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
            (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
         2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
         3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
         4) Drying Shrinkage: ASTM C1148; maximum 5 percent increase in shrinkage.
      b. Use only in combination with mortar that also has integral water repellent admixture.
      c. Use water repellent admixtures for masonry units and mortar by a single manufacturer.
   5. Finish Types
      a. Type 1:
         1) Basis of Design: York Building Products, Temple Stone in Slate color: www.yorkbuilding.com
         2) Substitutions: Prior approved equal.
      b. Type 2:
         1) Basis of Design: York Building Products, Rustic Face Stone. Color to match cast-in-place concrete foundations walls finish, as approved by Architect. www.yorkbuilding.com
         2) Substitutions: Prior approved equal.

2.2 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91/C91M, Type N.
   1. Colored Mortar: Premixed cement as required to match Architect's color sample.
B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
   1. Not more than 0.60 percent alkali.
C. Hydrated Lime: ASTM C207, Type S.
D. Mortar Aggregate: ASTM C144.
E. Water: Clean and potable.
F. Accelerating Admixture: Nonchloride type for use in cold weather.
G. Moisture-Resistant Admixture: Water repellent compound designed to reduce capillarity.
H. Packaged Dry Material for Mortar for Unit Masonry: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.

1. Color: Mineral pigments added as required to produce approved color sample.
2. Water-repellent mortar for use with water repellent masonry units.
3. Manufacturers:
    a. Amerimix, an Oldcastle brand; AMX 410: www.amerimix.com/#sle.
    b. Substitutions: Prior approved equal.

I. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.

1. Type: Fine.
2. Manufacturers:
    a. Amerimix, an Oldcastle brand; AMX 600: www.amerimix.com/#sle.
    b. Substitutions: Prior approved equal.

2.3 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:
1. Hohmann & Barnard, Inc: www.h-b.com/#sle.
2. WIRE-BONDwww.wirebond.com/#sle.
3. Substitutions: Prior approved equal.

2.4 FLASHINGS

A. Stainless Steel/Polymer Fabric Flashing: ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric.
1. Manufacturers:
    a. Hohmann & Barnard, Inc; Mighty-Flash Stainless Flashing: www.h-b.com/#sle.
    b. York Manufacturing, Inc; Multi-Flash SS: www.yorkmfg.com/#sle.
    c. Substitutions: Prior approved equal.

B. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.

2.5 ACCESSORIES

A. Joint Filler: Closed cell polyvinyl chloride; oversized 50 percent to joint width; self expanding; in maximum lengths available. Refer to structural drawings for location of joints.
1. Manufacturers:
    a. Hohmann & Barnard, Inc: www.h-b.com/#sle.
    b. WIRE-BOND;_____: www.wirebond.com/#sle.
    c. Substitutions: Prior approved equal.

B. Nailing Strips: Softwood lumber, preservative treated; as specified in Section 061000.

C. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.6 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Property Specification.
1. Interior, non-loadbearing masonry: Type O.
2. Exterior, loadbearing masonry: Refer to Structural Engineer’s recommendations.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.

D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly. Refer to Structural Engineer’s recommendations for loadbearing masonry admixture.

E. Mixing: Use mechanical batch mixer and comply with referenced standards.

2.7 ANTI-GRAFFITI COATING

A. All faces of concrete unit masonry in accessible range of public to be coated with Anti-graffiti surface protection finish. Refer to provided Graffiti-Resistant Coating, Section 09 96 23.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive masonry.

B. Verify that related items provided under other sections are properly sized and located.

C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.4 COURSING

A. Establish lines, levels, and coursing indicated by drawings. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
C. Concrete Masonry Units:
   1. Bond: Running.
   2. Mortar Joints: Concave.

3.5 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.
B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
C. Remove excess mortar and mortar smears as work progresses.
D. Interlock intersections and external corners as indicated by drawings.
E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
G. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.6 REINFORCEMENT AND ANCHORAGE - GENERAL AND SINGLE WYTHE MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
C. Place continuous joint reinforcement in first and second joint below top of walls.
D. Lap joint reinforcement ends minimum 6 inches.

3.7 GROUTED COMPONENTS

A. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
B. Place and consolidate grout fill without displacing reinforcing.
C. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.8 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.
B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
C. Size control joints as indicated on drawings; if not indicated, 3/4 inch wide and deep.
D. Form expansion joint as detailed on drawings.

3.9 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.
B. Install built-in items plumb, level, and true to line.
C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
   1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
D. Do not build into masonry construction organic materials that are subject to deterioration.

3.10 TOLERANCES

A. Maximum Variation from Alignment of Columns: 1/4 inch.
B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.11 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.
B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.12 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 014000 - Quality Requirements.

B. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140/C140M for compliance with requirements of this specification.

C. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.13 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

D. Use non-metallic tools in cleaning operations.

3.14 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION.

SECTION 051200 – STRUCTURAL STEEL – SITE STRUCTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Structural steel.
2. Grout.

1.3 DEFINITIONS

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

1.4 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections not specifically detailed on the Contract Documents to be selected or completed by structural-steel fabricator to withstand design loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC's *Steel Construction Manual*, edition as referenced in the Building Code.
2. Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

1.5 SUBMITTALS

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

B. Shop Drawings: Provide complete details and schedules for fabrication and shop assembly of members, erection plans, details, procedures, and diagrams showing sequence of erection of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Include shop drawings and calculations, signed and sealed by a professional engineer registered in the state of Texas.

C. Welding certificates and field welding procedure.

D. Qualification Data: For firms and persons specified in 1.6 “Quality Assurance” to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineers and owners, and other information specified.

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

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

F. Source quality-control test reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: company specializing in performing the work of this section with minimum 5 years documented experience.

B. Fabricator Qualifications: The special inspector verify that the fabricator maintains detailed fabrication and quality control of the workmanship and the fabricator’s ability to conform to approved construction documents and referenced standards. The special inspector shall review the procedures for completeness and adequacy relative to the code requirements for the fabricators scope of work.

1. Exception: Special inspections shall not be required where the work is done on the premises of a fabricator that is enrolled in a nationally accepted inspections program acceptable to the registered design professional in responsible charge. At completion of fabrication, the approved fabricator shall submit a certificate of compliance to building official upon request and to the registered design professional in responsible charge stating that the work was performed in accordance with the approved construction documents.

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

D. The latest adopted edition of all standards referenced in this Section shall apply unless noted otherwise. In case of conflict between these Contract Documents and the referenced standard, the Contract Documents shall govern. In case of conflict between these Contract Documents and the Building Code, the more stringent shall govern.

E. The Contractor shall furnish fabrication and erection inspection and testing of all welds in accordance with AWS D1.1. Submit records of inspections and tests to the Owner's testing laboratory for their review. The fabrication and erection inspectors shall be AWS certified welding inspectors.

F. All materials, fabrication procedures and field erection are subject to verification inspection and testing by the Owner's testing laboratory in both the shop and field. Such inspections and tests will not relieve the Contractor of the responsibility for providing materials and fabrication procedures in compliance with specified requirements.

G. Qualifications for Welding Work: Contractor shall be responsible for qualifying welding operators in accordance with the AWS "Standard Qualification Procedure." Provide certification to Owner's testing laboratory that welders to be employed in the work have satisfactorily passed AWS qualification tests. Recertification of welders shall be Contractor's responsibility.

H. Qualification of Welding Procedures: Contractor shall provide the testing laboratory with welding procedures which are to be used. Welding procedures shall be qualified prior to use in accordance with AWS D1.1, Part B.

I. Comply with applicable provisions of the following specifications and documents:

1. AISC's "Code of Standard Practice for Steel Buildings and Bridges”
2. AISC's "Seismic Provisions for Structural Steel Buildings" and "Supplement No. 2."
3. AISC's "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design."
4. ASTM A6 "Specifications for General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."
5. AISC's "Specification for the Design of Steel Hollow Structural Sections."
6. AISC's "Specification for Allowable Stress Design of Single-Angle Members."
7. RCSC's "Specification for Structural Joints Using High Strength Bolts."
8. AWS D1.1 "Structural Welding Code"

1.7 DELIVERY, STORAGE, AND HANDLING

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

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

1.8 COORDINATION

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

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. See project plans for specified structural steel material and grades.

1. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

B. Welding Electrodes: All welds shall be performed using E70XX electrodes. Electrodes used for carbon steel and weathering steel welds shall comply with AWS requirements.

2.2 STEEL GRATING

A. Steel grating for rain garden bridge shall be McNichols Bar Grating, Press-Locked, Carbon Steel, Rectangular Bar, GCM-1-100.

1. Welds or fasteners shall be provided in accordance with steel grating manufacturer recommendations.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. 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: Hot-dip zinc coating, ASTM A 153/A 153M, Class C.

B. Headed Anchor Rods: ASTM F 1554, Grade 55, straight.

1. Configuration: Per local standards.
2. Nuts: ASTM A 563 heavy hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 hardened carbon steel.
5. Finish: Hot-dip zinc coating, ASTM F2329.

2.4 PRIMER

A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.

B. Galvanizing Repair Paint: ASTM A 780.

2.5 GROUT

A. Cement Grout: 5,000 PSI compressive strength. Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. 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, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings."

1. Camber structural-steel members where indicated.
2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
3. Mark and match-mark materials for field assembly.
4. Plates shall be free of gross discontinuities such as ruptures and delaminations. Plates shall comply with ASTM A578, Level 1.
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.

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 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 and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 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 indicated otherwise.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Welds not specified shall be continuous fillet welds designed to develop the full strength of the member. A combination of welds and bolts shall not be used to transmit stress at the same face of any connections. Clean completed welds prior to inspection. Slag shall be removed from all completed welds.

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

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M. All steel shall be hot-dip galvanized, unless otherwise noted.

1. Fill vent holes and grind smooth after galvanizing.

2.9 POWDER COATING

A. Materials: All structural steel for the swing structure shall be powder coated following the structural steel being hot-dipped galvanized. Use powder coating consisting of an acrylic resin type with no vinyl or styrene modification. Provide a formulation that will not fade, yellow, or chalk within 10 years. Submit samples of acrylic powder material to the Engineer for approval.

1. No power coating for rain garden bridge.

B. Color: Contact the architect for color selection.

C. Storage: Follow the Manufacturer’s recommendations concerning handling and storage of materials.

D. Construction Methods: Follow the Manufacturer’s recommended procedures.

1. Send hot-dipped galvanized parts to the coater without passivation (no dichromate top layer).

2. Brush blast the parts to remove oxidation and soils. Other methods of removal require approval by the Engineer. Wipe parts with a cleaning solvent to remove any oily residues. If the powder coating is not applied within 24 hours after cleaning, reclean the surface.

3. If required, pre-heat in accordance with powder coating manufacturer's recommendations.

4. Apply Acrylic Powder to minimum 4 mils to maximum 10 mils.

5. Fully cure powder coating per powder Manufacturer's recommendations.

6. After all coating has been sufficiently cured per recommendation of the Manufacturer, wrap all coated pieces in paper and cardboard for direct shipment to the job site.

7. Repair scratches incurred at the job site with a solvent-based acrylic paint or patch kit recommended by the manufacturer.

2.10 SOURCE QUALITY CONTROL

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

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

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

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

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 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 will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Design of temporary bracing and supports shall be the responsibility of the Contractor. 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 deck 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's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings."

B. Base and Bearing Plates: Clean concrete bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of base plate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel and architecturally exposed structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Remove erection bolts on welded, architecturally exposed structural steel; fill holes with plug welds; and grind smooth at exposed surfaces.

G. Do not use thermal cutting during erection.

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

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

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: 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 otherwise noted.

B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work. Welds not specified shall be continuous fillet welds designed to develop the full strength of the member. A combination of welds and bolts shall not be used to transmit stress at the same face of any connections. Clean completed welds prior to inspection. Slag shall be removed from all completed welds.

1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings--Allowable Stress Design and Plastic Design" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Verify that weld sizes, fabrication sequence, and equipment used for architecturally exposed structural steel will limit distortions to allowable tolerances. Prevent weld show-through on exposed steel surfaces.

    a. Grind butt welds flush.
    b. Grind or fill exposed fillet welds to smooth profile. Dress exposed welds.

3.5 FIELD QUALITY CONTROL

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

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

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

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

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

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

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

3.6 REPAIRS AND PROTECTION

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

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

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

END OF SECTION 051200

SECTION 051200 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to requirements of Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the fabrication and installation of structural steel and related work, complete, in accordance with the Drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS

Submittals	Division 1
Quality Control	Division 1
Concrete	Section 033000
Steel Joists	Section 052000
Steel Deck	Section 053000
Miscellaneous Metals	Division 5
Fireproofing	Division 7
Painting	Division 9

1.4 CODES AND STANDARDS

A. Building Code: Structural steel work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:

1. American Institute of Steel Construction (ANSI/AISC 360) "Specification for Structural Steel Buildings" per Structural General Notes.
2. American Institute of Steel Construction (AISC 303), "Code of Standard Practice", shall apply except:
   a) Where a conflict exists between the Code of Standard Practice and the Contract Documents, the Contract Documents shall govern.
   b) In item 3.1.2 delete all references to item 4.4 and replace with the requirements of the project Specification.
   c) Item 3.6 shall be deleted.
   d) Item 4.4 shall be deleted, and replaced with the requirements of the project Specification.
   e) The second paragraph of item 7.10.3 shall be revised from “… owner’s designated representatives for design and construction” to “owner’s designated representative for construction or as indicated in the Contract Documents”
   f) The last sentence of items 8.5.2 and 8.5.4 shall be deleted.
   g) Item 8.5.3 shall be deleted.
3. American Welding Society, AWS D1.1, "Structural Welding Code".
4. Research Council on Structural Connections (RCSC) - "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
5. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
6. The Society for Protective Coatings (formerly Steel Structures Painting Council, “SSPC”) "Steel Structures Painting Manual".

C. Definitions:

1. The term “Contract Documents” in this Specification is defined as the design Drawings and the Specifications.
2. The term “SER” in this Specification is defined as the Structural Engineer of Record for the structure in its final condition.
3. The term “Design Professionals” in this Specification is defined as the Owner’s Architect and SER.
4. The term “Contractor” in this Specification is defined to include any of the following: General Contractor and their sub-contractors, Construction Manager, Structural Steel Fabricator or Structural Steel Erector.

5. The term “Heavy Shapes” in this Specification is defined to include hot rolled steel shapes with flanges exceeding 2 inches (50mm) in thickness and built up cross sections with plates exceeding 2 inches (50mm) in total thickness.
6. The term “High Restraint Weld” describes welds in which there is almost no freedom of movement for members joined due to geometry or material thickness.
7. The term “Testing Agency” in this Specification is defined as an independent testing and inspection service engaged by the Owner for quality assurance observation and testing of steel construction in accordance with applicable building code provisions and any additional activities listed in the Contract Documents.
8. The terms “for record” and “submit for record” in this Specification are defined as Contractor submittals that do not require a response from the Design Professionals.
9. The term “Working Days” in this Specification is defined as Monday through Friday, except for federal or state holidays.
10. The term “Delegated Design” in this Specification is defined as a scope of work that meets performance and design criteria established in the Contract Documents and is to be completed by the Contractor’s licensed engineer.

1.5 CONTRACTOR QUALIFICATIONS

A. Qualification Data: Submit for record qualification data (personnel and firm resumes, and project lists with references) for the Structural Steel Fabricator (“Fabricator”), Structural Steel Detailer (“Detailer”), Contractor’s Engineer(s) and Structural Steel Erector (“Erector”).

B. The Fabricator shall have 10 years of comparable experience in installations of this type and shall employ labor and supervisory personnel familiar with the type of installation, experienced in fabrication and erection of structural steel for projects of similar size and complexity. At the time of bid the Fabricator shall be AISC certified to the Standard for Steel Building Structures (BU) and must submit proof of these qualifications. The Fabricator’s qualifications shall be subject to review by the Design Professionals and Owner.

C. The Fabricator shall have particular experience in fabrication of large, welded, built-up sections, long span trusses.

D. The Detailer shall have 10 years experience preparing detailed steel shop drawings and CNC downloads for structures of this type and complexity. The detailer’s qualifications shall be subject to review by the Design Professionals and Owner. All detailing shall be performed with 3D modeling software, such as TEKLA STRUCTURES, SDS-II or equivalent. Model shall be maintained to be current throughout the construction and in a form useable by the Design Professionals.

E. The Contractor’s Engineer(s) shall be qualified to perform the type of work required by the project. The Engineer shall be a Professional Engineer licensed in the state where the project is located. The Contractor’s Engineer(s) shall have 10 years of experience being in responsible charge of work of this nature. The proposed Engineer(s) shall be subject to approval of Design Professionals and Owner.

F. The Erector shall have 10 years of successful experience erecting structural steel for structures of this type and complexity in the region of the project. At the time of bid the Erector shall be an AISC Advanced Certified Steel Erector (ACSE) and must submit documentation of this qualification.

G. Welding: Qualify the welding procedures, shop welders, field welders, welding operators and tackers in accordance with AWS D1.1 and for the following periods of effectiveness of certification:
   1. Certification and qualification, including period of effectiveness of welding personnel shall be as specified by AWS D1.1. Certification shall remain in effect for duration of work provided welders are continuously engaged in performing the type of welding for which they are certified, unless welders fail to perform acceptable welding, as determined by the Owner’s Testing Agency. Certification and re-certification of welding personnel is subject to verification by the Testing Agency. Re-testing for re-certification will be the Contractor's responsibility.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested. Reproduction of structural drawings for shop drawings is not permitted.
   (1) Submittal Schedule
   (2) Calculations, Shop Drawings and Erection Drawings
   (3) Submittal Letters
   (4) Pre-construction Survey
   (5) Erection Procedure

(6) Quality Control Program
(7) Product Data
(8) Samples
(9) Welding Procedures Specification (WPS)
(10) Welder Certifications
(11) Mill Reports
(12) As-built surveys

1. Submittal Schedule: The contractor shall submit for action a typical connection design calculation and shop drawing submission schedule at least twenty (20) working days prior to commencing submission of connection design calculations and shop drawings.
   a) This schedule shall include a list, in order of date to be submitted, of all drawings and other required submittal items scheduled to be submitted. The schedule shall list the proposed submittals for each week, including but not limited to the number of calculation sheets, erection drawings, and piece drawings, as well as their formats. Once shop drawing submissions have commenced any modification or addition to this schedule must be submitted for action at least twenty (20) working days before the modification or addition is proposed to take place.
   b) If at any time the total number of connection design calculations, erection drawings and shop drawings received in any one week period exceeds the amount in the approved schedule by more than 10% for that week, the Design Professionals have the right to add two days to the average turnaround time for each 20% increment in excess of the scheduled quantity for that week's submissions. For example if the weekly total exceeds the schedule by 10% to 20%, two days may be added; if it is exceeded by 21% to 40%, four days may be added. The return dates for subsequent submittals may be extended based on the additional review time stated above.
   c) For the purposes of developing a schedule, assume the following review rates:
      Calculations – 100 – 8 ½' x 11" sheets per week
      Shop drawings – 300 pieces per week
2. Calculations, Shop Drawings and Erection Drawings (including Field Work drawings): Submit for action required connection calculations, shop drawings and erection drawings for all structural steel indicated on the Contract Documents.
   a) Material shall not be fabricated or delivered before the shop and erection drawings have been approved or approved as noted by the Design Professionals and returned to the Contractor.
   b) Connection design calculations: Calculations are required for all details that are not indicated on the Drawings as "Completely Designed." Each calculation package shall be sealed and signed by the Contractor's Engineer.
   c) Structural Steel Shop Drawings: Submitted shop drawings shall include layouts and details for each member showing the steel type and grade, size, connections, cuts, copes, holes, bolts, welds, surface treatments (cleaning, shop paint, etc.) and provisions for the connection of other work. Steel type, grade and size for all attached elements shall also be shown.
   d) Shop and erection drawings shall contain complete dimensional and geometric information, based on established dimensions shown on Contract Documents, and shall not be scaled from Contract Documents. The shop drawings shall clearly distinguish between shop and field welds and bolts, identify pretensioned high strength bolts and identify surface preparation requirements at slip critical connections.
   e) Welds: All welds shall be indicated by standard welding symbols in the "Standard Code for Arc and Gas Welding in Building Construction" or as accepted by the SER. Shop and erection drawings shall show the size, length, and type of each weld, including the electrode type to be used.
   f) Bolts: Details for bolt assemblies shall indicate bolt size, length, type and the presence, type and location of washers where required as part of the assembly; distinguish between N and X bolts, distinguish between slip-critical and bearing bolts; specify approved slip critical coatings; and distinguish between shop and field bolts. Also, indicate bolt orientation where required by the Contract Documents.
   g) Erection Drawings: The erection drawings shall include plans showing exact locations of base and bearing plates, and/or anchor rods and other embedded items. All field connections not specifically shown on shop drawings shall be shown on erection drawings, including field bolt size, type, number, location and any special installation requirements, and field weld size, type, length and location.

3. Submittal Letters: The Contractor shall submit for record letters from the Contractor's Engineer supervising the preparation of connection designs on shop and erection drawings.
   a) A letter shall be submitted along with the first submission of Connection design calculations. It shall be sealed and signed by the Contractor's Engineer, and shall include the following: "All Connection design calculations for this project have been developed, and all details and connections for this project will be designed, by me, or by qualified personnel under my direct supervision, to resist the loads and reactions indicated on the Contract Documents, except for those connections which are designated as completely designed on the Contract Drawings."
   b) A second letter shall be submitted upon the satisfactory submission, review and/or approval of all shop and erection drawings. It shall be sealed and signed by the Contractor's Engineer and include the following:
   "All details and connections as shown on the final shop and erection drawings for this project have been designed by me, or by qualified personnel under my direct supervision, to resist the loads and reactions indicated on the Contract Documents, except for those connections which are designated as completely designed on the Contract Drawings."
4. Preconstruction Survey: Submit for record. Where interface with existing construction occurs, before related shop drawings are prepared survey the existing construction and submit the survey prepared by a professional surveyor employed by the Contractor to the Design Professionals. For all steel construction, before steel erection commences, perform and submit to the Design Professionals a complete survey for position and alignment at all points where construction by other trades will support steel elements, including but not limited to pockets, embedded plates, anchor rods and base plates. Include plan location positions relative to the building gridlines and elevations of bearing surfaces and tops of bolts relative to building Datum elevation. Immediately notify the SER of elements that are not within tolerance.
5. Erection Procedure: Submit for action a steel erection procedure, prepared under the supervision of the Contractor's Engineer, for review by the SER. The review by SER shall only be for the effects of the steel erection procedures on the final structure. This erection procedure shall, at a minimum, meet requirements outlined on the Contract Documents and shall bear the seal and signature of the Contractor's Engineer. No deviation from the approved procedure will be permitted without prior written approval by the Contractor's Engineer and review by the SER.
6. Quality Control Program: Submit for record complete details of the Contractor's quality control program including the names of the personnel responsible for this work.
7. Product Data: Submit for action manufacturers' specifications, test reports and applicable standards for all products listed under Part 2: Products. Standard literature shall be edited to suit job conditions.
8. Samples: Submit for record (2) samples each, (2) of shop painted products and (2) of field touch-up painted products. Samples shall be steel material.
9. Welding Procedures Specification (WPS): Submit for record written welding procedures for all AWS D1.1 prequalified joints, and qualification procedures for all joints not prequalified by Section 3 of AWS D1.1. Submit written welding procedures developed by Contractor’s welding consultant for Heavy Shapes and High Restraint Welds described in this Specification. Use the forms in AWS D1.1, Annex M. Submit all welding and qualification procedures to the Owner's Testing Agency for approval before submitting to the Design Professionals.
10. Welder Certification: Submit for record certification that the welders have passed qualification tests acceptable to the governing authority] using AWS procedures.
    a) A certification shall be submitted in standard AWS format.
    b) Each certification shall state that the welder has been doing satisfactory welding of the required type within the six-month period prior to the subject work.
    For any welder whose period of certification effectiveness has lapsed or whose workmanship is subject to question in the opinion of the Design Professionals or Testing Agency, immediate testing for recertification will be required. Tests, when required, shall be conducted at the sole expense of the Contractor.
11. Mill Reports: Submit for record certified copies of all mill reports to the Design Professionals and to the Testing Agency, covering the chemical and physical properties of all structural steel and accessories (as defined in this Specification) for the project. Where required on the Contract Documents or by the AISC Code, reports shall include results of Charpy V-notch tests.
    a) Such certificates shall be obtained from the mills producing the steel and shall certify in a cover letter submitted with the certificates, that the steel meets the minimum requirements as to physical properties, inspection, marking and tests for structural steel as defined by the current edition of the relevant ASTM Standard Specifications. Any steel that does not meet

the ASTM requirements must be clearly identified in a cover letter submitted with the certificates.

b) Prior to commencing steel erection, the contractor shall deliver certificates to the Owner in number and form as may be required by the local Building Department or other local and State agencies having jurisdiction.

12. As-Built Surveys: Execute and submit for record a comprehensive survey of steel structure at each level adequate to assess if the structure has been built within the tolerances specified in the Contract Documents. Each certified survey, performed by a professional surveyor employed by the Contractor, shall be submitted to the Contractor's Engineer for their approval before proceeding to the next stage of erection. If deviations from the tolerances are discovered, the Contractor shall present corrective measures to the Design Professionals within 48 hours of completion of that stage of erection. Upon completion of steel erection, submit the complete package of steel surveys for record to the Design Professionals and the Owner.

B. Submittal Process

1. Submittal of shop and erection drawings and other submittals by the Contractor shall constitute Contractor's representation that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog numbers and similar data with respect thereto and reviewed or coordinated each drawing with other Drawings and other trades. The Contractor shall place their shop drawing stamp on all submittals confirming the above.
2. Connection design calculations: Calculations are required for all details that are not indicated on the Drawings as "Completely Designed." The Contractor shall submit connection design calculations and receive an action of approval prior to submitting shop drawings related to those calculations. The shop drawings shall incorporate all comments provided on the calculations.
3. Shop and erection drawings: Submit in complete packages so that individual parts and the assembled unit may be reviewed together. This Specification Section and the applicable drawings used in the development of the shop and erection drawings shall be referenced on each shop and erection drawing to facilitate checking. Unless the piece marks are self-indexing, furnish index sheets with the shop drawings, relating piece marks for all beam, girder and column details to the sheet numbers on which they are located.
4. The Contractor shall submit to the Design Professionals one (1) electronic copy for shop drawing review. The naming convention of each drawing must follow the submittal numbering system and include the submittal #, specification #, revision # and drawing # in the prefix of the drawing name.
5. The Contractor shall allow at least ten (10) working days between receipt and release by the SER for the review of shop and erection drawings and submittals other than connection design calculations. The Contractor shall allow at least fifteen (15) working days between receipt and release by the SER for the review of connection design calculations.
6. All modifications or revisions to submittals, shop drawings, connection design calculations and erection drawings must be clouded, with an appropriate revision number clearly indicated. The following shall automatically be considered cause for rejection of the modification or revision whether or not the drawing has been approved by the Design Professionals:
   a) Failure to specifically cloud modifications
   b) Failure to submit calculations for the modifications
   c) Unapproved revisions to previous submittals
   d) Unapproved departure from Contract Documents
7. The Contractor shall deliver to the Design Professionals at the completion of the job two (2) electronic versions of the final as-built shop drawings on a CD-ROM or other media acceptable to the Design Professionals.
8. Resubmittals: Completely address previous comments prior to resubmitting a drawing. Resubmit only those drawings that require resubmittal.
9. Resubmittals Compensation: The Contractor shall compensate the Design Professionals for submittals that must be reviewed more than twice due to contractors' errors. The Contractor shall compensate the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%.

C. SER Submittal Review

1. The review of connection design and the review and approval of shop and erection drawings and other submittals by the Design Professionals shall be for general conformance with the design intent of the work and with the information given in the Contract Documents only and will not in any way relieve the Contractor or the Contractor's Engineer from:
   a) Responsibility for the adequacy of the design of the connections designed by the Contractor's Engineer.
   b) Responsibility for all required detailing.

c) Responsibility for the proper fitting of construction work in strict conformance with the contract requirements.
d) The necessity of furnishing material and workmanship required by contract Drawings and Specifications which may not be indicated on the shop and erection drawings.
e) Conforming to the Contract Documents.
f) Coordination with other trades.
g) Control or charge of construction means, methods, techniques, sequences or procedures, for safety precautions and programs in connection with the work.

2. TYPE 1 – Structural Submittal Review Stamp: For shop drawings for building elements designed by the SER, the responses on the shop drawing review stamp used by the SER require one of the following actions:
   a) APPROVED indicates that the SER has found that the information presented on the shop or erection drawing appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
   b) APPROVED AS NOTED indicates that the SER requires the shop or erection drawing to be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected shop or erection drawing for record.
   c) REVISE and RESUBMIT indicates that the SER requires resubmission of the shop or erection drawing after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
   d) NOT APPROVED indicates that the shop or erection drawing does not conform to the Contract Documents and must be extensively revised before re-submittal. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed until the Contractor has received a returned shop drawing marked Approved or Approved as Noted.
3. TYPE 2 – Delegated Design Review Stamp: For submittals for building elements which are not designed by the SER but are delegated design items, or for items that do not form part of the completed structural system but impose loads on the structure, or for construction items or activities which have an effect on the final structure. The responses on the stamp used by the SER require one of the following actions:
   a) NO EXCEPTIONS indicates that the SER has found that the information presented on the submittal appears to conform to the requirements of the Contract Documents. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the Contract Documents.
   b) EXCEPTIONS NOTED indicates that the SER requires the submittal be corrected to reflect the notes and comments shown. Fabrication, manufacture or construction of the elements of work shown in the shop drawing may proceed, provided that work is in compliance with the notations shown on the shop drawings and the Contract Documents. Promptly resubmit the corrected document for record.
   c) REJECTED indicates that the SER requires resubmission of the submittal after correction per notes and comments. None of the elements of work shown on the shop drawing shall be fabricated, manufactured or constructed. Contractor to revise and resubmit until SER response of No Exceptions or Exceptions Noted is received.

D. Substitution Request
1. Requests for any departure from Contract Documents must be submitted in writing by the Contractor and accepted in writing by the Design Professionals, prior to receipt of submittals.
2. All substitutions must be requested using the structural substitution request form included at the end of this section. Acceptance using the structural substitution request form indicates acceptability of the structural concept only. Contractor must submit shop drawings reflecting accepted substitutions for review in accordance with this Specification. The structural substitution request form, even if accepted, does not constitute a change order.
3. Such substitutions or modifications, if acceptable to the Design Professionals shall be coordinated and incorporated in the work at the sole expense of the Contractor.
4. The acceptance by the Design Professionals of a specific and isolated request by the contractor to deviate from these requirements does not constitute a waiving of that requirement for other elements of, or locations in the project, unless specifically addressed as such and permitted by the Design Professionals in writing.

5. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated for the review and/or incorporation of the Contractor-requested substitution, including indirect effects on other portions of the work, the Contractor is responsible for paying for additional work performed by the Design Professionals at the standard billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.
6. Contractor is responsible for means and methods and any impacts on other portions of the work that may arise from this substitution.

E. Request for Information (RFI)
1. RFI shall originate with the Contractor. RFI submitted by entities other than that Contractor will be returned with no response.
2. Limit RFI to one subject.
3. Submit RFI immediately upon discovery of the need for interpretation or clarification of the Contract Documents. Submit RFI within timeframe so as not to delay the Construction Schedule while allowing the full response time described below.
4. The response time for answering an RFI depends on the category in which it is assigned.
   a) Upon receipt by the SER, each RFI will be assigned to one of the following categories:
      i. No cost clarification
      ii. Shown in Contract Documents
      iii. Change to be issued in future bulletin
      iv. Previously answered
      v. Information needs to be provided by others.
      vi. Request for corrective field work
      vii. Request for substitution
   b) RFIs in the first five categories listed above will be turned around by the SER on average of five (5) working days.
   c) RFIs in the last two categories listed above will be immediately rejected and must be submitted as submittals or requests for substitution.

1.7 TEMPORARY SUPPORT OF STRUCTURAL STEEL FRAME

The structure as shown on the Contract Documents is designed to withstand the design loads only when all structural elements are installed and fully connected. The contractor shall be responsible for the analysis of all components and assemblies for stresses and displacements that may be imposed by fabrication, shipping, handling, erection, temporary conditions, construction loads, etc. The analysis of such shall be performed by the Contractor's Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Unload all structural steel promptly upon arrival and store in an area designated and approved by the Owner at the site of the work. The Contractor shall be responsible for any charges from failure to unload material promptly.

B. Storage: Store structural steel to drain properly. Provide weep holes and clean out as required to keep steel free from water. Provide adequate protection and shoring to prevent distortion and other damage. Store structural steel on timber; do not lay on mud, directly on ground or cinders, or otherwise handle in a manner that damages finishes. Stored sections shall be readily accessible for inspection.

C. Store fasteners in a protected place.

D. Welding materials to be in moisture resistant, undamaged package. Maintain packages effectively sealed until electrode is required for use. Storage and handling shall be per AWS D1.1. Limit exposure on FCAW Electrodes per AISC 341, Appendix W.

1.9 CONNECTION DESIGN AND DETAILING CONFERENCE

A. At least 20 working days prior to starting connection design and detailing, the Fabricator shall hold a meeting to verify all connection design assumptions and procedures and shop drawing preparation and submittal procedures.

B. The Contractor shall prepare an agenda and require responsible representatives of every party who is concerned with the connection design and detailing to attend this meeting, including but not limited to:
1. General Contractor
2. Fabricator
3. Detailer
4. Connection Engineer

5. Design Professionals
6. Erector

C. The Fabricator shall prepare an agenda prior to the meeting, and shall distribute meeting minutes to all parties within 5 working days of the meeting.

1.10 DESIGN OF CONNECTIONS

A. The contractor is responsible to design all connections not completely designed on the Contract Documents. A Completely Designed connection is only one that is specifically designated as such by the statement “COMPLETELY DESIGNED” on the Contract Documents. All connections not indicated as “COMPLETELY DESIGNED” shall be designed for the forces and/or connection design criteria called for in the Contract Documents.

B. Connection concepts shown on the Drawings that are not “COMPLETELY DESIGNED” show only the minimum requirements to convey design intent.

C. All connections and details shown on shop and erection drawings shall be prepared under the supervision of the Contractor's Engineer, in accordance with AISC "Load and Resistance Factor Design Specification for Structural Steel Buildings."

D. The contractor shall design and provide any stiffener plates, doubler plates, reinforcing plates, etc. and their connections that may be required to develop and/or transfer the forces and/or connection design criteria called for in the Contract Documents.

E. Design connections to withstand the combined effects of shears, axial forces, moments and torques and as required by applicable code(s) and the Contract Documents.

F. All forces shown on the Drawings are to be assumed reversible unless noted otherwise and must be checked for both directions. If no transfer/pass-through forces are shown on the Contract Documents, the most critical combinations of member forces and directions shall be assumed for the connection design.

G. Use types of shop and field connections shown on Contract Documents or, in absence of such indication, propose appropriate type for Design Professionals review.

H. Welding of High Restraint Welds: Use double bevels in lieu of single bevels where practical. Detail joints to allow for weld shrinkage. In cases of plates in more than one plane, show welding operation sequence on the drawings. In general, start welding at the most restrained part of the weldment and proceed to the least restrained.

I. All welded connection must utilize pre-qualified joints or joints that have been qualified by AWS D1.1, section 2.

J. Comply with all connection notes on Drawings in conjunction with these Specifications.

K. The connection design calculation submittals shall meet the following criteria:
   1. Number each calculation in a logical and orderly system. Once submitted for review, calculations shall not be renumbered. Resubmitted calculations shall be indicated by using the same number with an “R” suffix. All changes must be clouded.
   2. Provide sketches for results of each calculation, with all pertinent dimensions relating to the calculations (including pitch, gage, edge distance, unbraced lengths, Whitmore lengths, etc.) clearly shown. Geometry must be shown accurately and to scale. Provide enough sketches to clearly document the full range of geometric conditions applicable to each connection design calculation proposed.
   3. For repetitive connections provide a spreadsheet or computer program summary table for each specific location, and a standard calculation which shows how the spreadsheet or program calculation applies.
   4. Provide drawings showing the overall locations of the connections that are keyed/referenced to each connection calculation.
   5. Calculations shall be typed, or performed by spreadsheet, or by computer program, or by other method approved by the SER. All spreadsheet calculations shall show the input and results for every calculation step and include appropriate text and sketches explaining all calculation assumptions.
   6. Provide calculation checks for all forces shown on the Drawings. All AISC code requirements apply. Provide calculations for each check. “OK by inspection” is not permitted.

1.11 STRUCTURAL STEEL PRE-ERECTION CONFERENCE:

A. At least twenty (20) working days prior to the commencing of steel erection the Contractor shall hold a meeting to review the detailed requirements of the steel erection.

B. The Contractor shall prepare an agenda and require responsible representatives of every party who is concerned with the steel erection to attend the conference, including but not limited to the following:
   1. General Contractor/Construction Manager

2. Steel Erector / Steel Fabricator
3. Erector's Surveyor
4. Roof Deck Contractor
5. All Testing and Inspection Agencies
6. Design Professionals
7. Owner
8. Precast or Cladding Contractor as appropriate.

C. Minutes of the meeting shall be recorded, typed and distributed by the Contractor to all parties listed above within 5 working days of the meeting.

D. The minutes shall include a detailed outline of the erection procedure including a schedule of milestone dates for surveys and sign-offs on erection stages which represents an agreement reached by all parties involved. It shall also include the surveying program and submission schedule for approval.

E. Notwithstanding any provision of the Specification, the SER shall not be responsible for and not have charge over any safety programs or precautions at the site of the Project.

1.12 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. Quality assurance is testing and inspection to assist the Owner in evaluating the Contractor's performance and quality control in the fabrication shop and field. It is not a substitute for the testing and inspection which is required as part of the Contractor's quality control program (see the following section on quality control).

B. Cost: Except as specifically noted otherwise, the testing agencies for quality assurance shall be engaged and paid by the Owner.

C. The Owner has negotiated inspection services based upon the assumption that all fabrication work shall be performed at one single fabrication shop. Costs associated with work being performed in additional shops will require reimbursement to the Owner.

D. Coordination with Owner's Testing Agency: The Contractor shall have sole responsibility for coordinating their work with the Owner's Testing Agency to assure that all test and inspection procedures required by the Contract Documents and Public Agencies are provided. The Contractor shall cooperate fully with the Owners testing agencies in the performance of their work and shall provide the following:
   1. Information as to time and place of starting shop fabrication and a field construction and erection schedule, one week prior to the beginning of the work.
   2. Site File: At least one copy of each approved shop drawing shall be kept available in the contractor's field office and the drawings not bearing evidence of approval and release for construction by the Design Professionals shall not be kept on the job. Provide drawings for the work to be performed in the shop or field one week prior to the start of work.
   3. Representative sample pieces requested by the inspection agency for testing, if necessary.
   4. Full and ample means of assistance for testing and inspection of material.
   5. Proper facilities, including scaffolding, temporary work platforms, safety equipment etc., for inspection of the work in shop and field.

E. Duties of the Owner's Testing Agencies:
   1. Reports: The Testing Agency shall prepare daily reports of the structural steel work including progress and description/area of work, tests made and results. Reports of inspection of welding shall include deficiencies noted and corrections made, and other items pertinent to acceptance or rejection of the work. The reports shall state whether specimens comply with or deviate from contract requirements. The daily reports shall be collected and delivered to the Design Professionals and Owner weekly.
   2. Rejection: The Owner's Testing Agency has the right to reject any material, at any time, when it is determined that the material or workmanship does not conform to the Contract Documents. The Testing Agency shall immediately notify the Owner, Design Professionals, and Contractor of deficiencies.
   3. Structural steel work and general testing requirements: The Testing Agency shall perform the following shop and field inspections in addition to any other inspections enumerated above or specified on the Contract Documents:
      a) Shop inspection of steel shall include alignment and straightness of members, camber, preparation for connections, dimensional checks, testing of shop bolts, witnessing of welding procedures, testing of cuts, weld access holes and copes of Heavy Shapes as defined in this Specification, examination and testing of completed welds, headed studs and deformed bar anchors, cutting of Heavy Shapes, finishing of column ends, cleaning, painting and storage of material. All shop fabrication shall be inspected in the shop. Camber shall be verified in a minimum of 10% of all members requiring camber. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable cambers, the

required percentage of tested cambers may be increased by the SER to 100% at no expense to the Owner.

b) Field inspection of steel shall include connections, proper tensioning of bolts, levelness, plumbness and alignment of the frame, conformance to AWS welding methods, examination of surface before welding, examination and testing of completed welds, headed studs and deformed bar anchors and field painting, including touch-up.

c) Check the following in the shop and in the field:
   i. Welding certificates, procedures, and personnel
   ii. Stud welding setup and operators
   iii. Bolting procedure and crew

d) Where testing is required for less than 100% of locations, select test locations at random and throughout the project.

e) Review mill certifications for compliance with the Contract Documents.

4. High Strength Bolting: The Testing Agency inspector shall inspect high strength bolted construction in accordance with RCSC "Specification for Structural Joints using ASTM A 325 or A 490 Bolts," including but not limited to:
   a) Surface preparation and bolt type conforms to plans and Specifications prior to start of bolting operations.
   b) Proper bolt storage and handling procedures per codes and standards referenced by this Specification are being followed.
   c) Visually inspect all bolted connections.
   d) For all bolted connections that are indicated as snug tight, connections are properly compacted and brought to the snug tight condition progressing outward from the most rigid part.
   e) For all bolted connections that are indicated as pretensioned or slip critical, pre-installation verification testing is performed by the inspector in cooperation with the contractor in accordance with RCSC section 9.2 and section 7.
   f) For all bolted connections that are indicated as pretensioned or slip critical, through routine observation, as defined in RCSC 9.2.1, 9.2.3 or 9.2.4, that the pretensioning methods of RCSC 8.2.1, 8.2.3, or 8.2.4, as appropriate, are performed.
      i. "Routine observation" is defined as observation of 10 bolts for every 100 bolts with a minimum of 2 bolts per connection.
   g) Retest bolted connections that fail initial inspection after correction by the Fabricator or Erector.

5. Welding:
   a) Review of submittals: Welding procedures including prequalification, qualifications test and, for Heavy Shapes and High Restraint Welds, the welding procedure prepared by the Contractor's Engineer or Welding Consultant.
   b) Complete Joint Penetration welds: Test all complete joint penetration welds for soundness by means of either radiographic or ultrasonic testing in accordance with AWS D1.1 and ASTM E164 procedures. All flaws in plate or flange material revealed during such tests shall be repaired and retested by the Contractor at the Contractor's expense.
   c) Partial Joint Penetration welds: Test all partial joint penetration welds for soundness by means of visual and magnetic particle inspection, unless other methods are specified in the Contract Documents. All flaws in plate or flange material revealed during such tests shall be repaired and retested by the Contractor at the Contractor's expense.
   d) Testing of welds at Heavy Shapes and High Restraint Welds shall be performed not less than 48 hours after the weld has been completed.
   e) Fillet welds: Visually inspect all fillet welds. In addition test ten percent (10%) of all fillet welds using a non-destructive method, such as dye penetrant or magnetic particle. Select test locations randomly throughout the structure, but test at least one weld in each location with 6 or more welds per connection. If, in the opinion of the SER and Testing Agency this testing discloses a large ratio (10% or more) of unacceptable welds, the required percentage of tested welds may be increased by the SER to 100%, all at the Contractor's expense.
   f) Inspection and Testing by the Testing Agency of High Restraint Welds and where Heavy Shapes are to be joined by partial or complete joint penetration welds in tension:
      i. Joint Preparation: Monitor fit up and joint preparation (bevel angle, etc.) for conformance to the submitted welding procedures including preheat and interpass temperature. Monitor base metal temperature during welding operations.
      ii. Test Complete Joint Penetration Welds in accordance to the requirements of this Specification section, ultrasonically in accordance with AWS D1.1 procedures. On T

or corner joints, pay careful attention to the heat affected zone and base metal where the weld shrinkage stresses are in the through thickness direction.

iii. Test Partial Joint Penetration Butt Joints in accordance with this Specification section by the magnetic particle method. At T or corner joints, in addition to the magnetic particle testing, ultrasonically scan the heat affected zone and adjacent base metal from face "C" per AWS D1.1 Table 6.7 and Annex Q7 to detect lamellar tears and shall be done with a compression wave. The Testing Agency shall submit a testing procedure that includes evaluation (acceptance criterion) procedures to the Design Professionals for review.

g) At Heavy Shapes and High Restraint Welds: provide pre-production sample testing of heat treatment, observe fabrication, welding and heat treatment of the samples for conformance with submitted welding procedures. Establish locations of testing coupons following AWS procedures. Test coupons following AWS procedures to verify satisfactory results using the welding procedure and heat treatment.

6. Headed Studs and Deformed Bar Anchors: Visually inspect all headed studs and deformed bar anchors for complete fusion and full 360-degree weld flash (or fillet).
   a) Check all studs with incomplete fusion, and at random five studs at each of six beams per floor, by bending to an angle of 15 degrees from its original axis (away from any missing flash). If more than twenty percent of studs fail on one member, check all studs on member. In addition, for each member with any defective studs, test an additional member.
   b) Contractor to replace any studs that crack or break. Contractor to only straighten studs that would foul other work or have less than 1 inch (25mm) cover in bent position.
7. Cleaning & Painting:
   a) Examine shop painting to verify conformance with this Specification.
   b) Examine loading and unloading of steel to visually observe that damage does not occur during shipping and handling.
8. Remedial Work: The Testing Agency shall indicate to the Contractor where remedial work must be performed and will maintain a current list of work not in compliance with the Contract Documents. This list shall be submitted to the Design Professionals and Owner on a weekly basis.
9. Certification: When all work has been approved by the Testing Agency, the Testing Agency shall certify in a letter to the Design Professionals and Owner that the installation is in accordance with the design and Specification requirements (including applicable codes).

1.13 QUALITY CONTROL BY CONTRACTOR

A. The Contractor shall provide a program of quality control to ensure that the minimum standards specified herein are attained.

B. The Owner's general review during construction and activities of the Owner’s Testing Agency are undertaken to inform the Owner of performance by the Contractor but shall in no way replace or augment the Contractor's quality control program or relieve the Contractor of total responsibility for quality control.

C. The Contractor shall immediately notify the Design Professionals of any deficiencies in the work which are departures from the Contract Documents which may occur during construction. The Contractor shall propose corrective actions and their recommendations in writing and submit them for review by the Design Professionals. After proposed corrective action is accepted by the Design Professionals and Owner, the Contractor shall correct the deficiency at no cost to the Owner. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in the OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS section of this Specification.

1.14 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS

A. Observations: The Design Professionals will observe the construction for general compliance with the provisions of the Contract Documents during various phases of construction.

B. Corrections by Design Professionals: See Part 3 - CORRECTIVE MEASURES section of this specification.

1.15 PERMITS AND WARRANTY

A. Permits: The Contractor shall apply for, procure, renew, maintain, and pay for all permits required by City, State, or other governing authorities, necessary to execute work under this Contract. Contractor shall furnish copies of all permits to the Owner and Design Professionals.

B. Warranty: Comply with General Conditions, agreeing to repair or replace specified materials or Work that has failed within the warranty period.

PART 2 - PRODUCTS

2.1 STRUCTURAL STEEL

A. Structural steel shall conform to the requirements listed on the Structural General Notes.

B. “Heavy Shapes” as defined in this Specification require minimum Charpy impact values per the Structural General Notes, in addition to any other members stated in the Notes.

2.2 SHOP COATINGS

A. Standard Primer: Rust inhibitive, universal phenolic alkyd metal primer 2-4mls. Color to be determined by Architect. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.

B. Zinc Rich Primer: SSPC-Paint 20, Type I or Type II, Zinc rich primer utilizing either an organic or inorganic binder with a minimum zinc content of 80 percent by weight in the dry film. The primer shall provide a surface meeting AISC Slip Critical Class B (slip coefficient =0.50 min) requirements. Color to be determined by Architect. Primer shall be compatible with, and from the same manufacturer as, top coats specified in Division 9 specification.

C. Hot Dip Galvanizing: ASTM A123, weight of coating shall average not less than 2.3 oz per square foot (0.70 kg/ m²), with no individual thickness less than 2.0 oz per square foot (0.61 kg/m²).

D. Galvanizing Repair Paint: ZRC Cold Galvanizing Compound, or other coating complying with SSPC-Paint 20.

2.3 ACCESSORIES

A. High Strength Bolts: Conform to the provisions of the Research Council on Structural Connections (RCSC) "Specification for Structural Joints Using High-Strength Bolts" except that nuts shall be ASTM A563 Grades DH or DH3 (hardened) for both A325 and A490 bolts. Twist off type bolts (Tension Control bolts) shall additionally conform to ASTM F1852 or ASTM F2280.

B. All bolts shall be new, and not re-used.

C. Where A325 galvanized bolts nuts and washers are required, they shall be in accordance with ASTM F2329 and ASTM A153, Class C. Where A588 steel is used, bolts, nuts and washers shall be Type 3.

D. Direct Tension Indicators: Meet requirements of ASTM F959.

E. Anchor Rods: Per structural General Notes.

F. Washers:

1. Round washers shall conform to American Standard B 27.2 type b
2. Washers in contact with high-strength bolt heads and nuts shall be hardened in accordance with ASTM Standard F436.
3. Beveled washers shall be square, smooth and sloped so that contact surfaces of the bolt head and nut are parallel.
4. The diameter of the hole of square beveled washers shall be 1/16 inch (1.5mm) greater than the bolt size for bolts smaller than one inch (25mm), and shall be 1/8 inch (3.0mm) greater than the bolt size for bolts larger than one inch (25mm).
5. Comply with requirements of RCSC for all washers including thickness, size and hardness, depending on connection details.

G. Welding Electrodes: Electrodes shall be low hydrogen and shall be selected from Table 3.2 of AWS D1.1. Comply with CVN requirements of the Structural General Notes.

1. Shielded Metal-Arc Welding: Welding electrodes for manual shielded metal-arc welding shall conform to the specification for Mild Steel Covered Arc-Welding Electrodes, AWS A5.1 E70 or 80, or the specification for Low-Alloy Steel Covered Arc-Welding Electrode, AWS A5.5.
2. Submerged-Arc Welding: Bare electrodes and granular flux used in submerged-arc welding shall conform to F70 or F80 AWS flux classifications of the specification for Gare Mild Steel Electrodes and Fluxes for submerged-arc Welding, AWS A5.17.
3. Where Charpy V-Notch values are required on the base metal, an electrode meeting the Charpy V-Notch requirements listed in the Structural General Notes shall be provided.

H. Headed Studs (shear connectors) shall be per Structural General Notes.

I. Deformed Bar Anchors shall be as specified in Structural General Notes.

J. Steel Castings shall conform to ASTM A27, Grade 65-35, medium strength carbon steel.

K. Grout: Refer to General Notes.

L. Post-installed Anchors shall be per Structural General Notes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Work by Others: Examine all work prepared by others to receive work of this Section and report any defects affecting installation to Design Professionals. Commencement of work will be construed as complete acceptance of preparatory work by others. The Contractor alone shall be responsible for checking the dimensions and coordination of the structural steel work with other trades.

B. Anchor Rods: At least 20 working days prior to the start of the structural steel erection, the Contractor shall ascertain by accurate survey the existing location, alignment, and elevation of the anchor rods embedded in the concrete by others. The Contractor shall immediately notify the Design Professionals of any discrepancies observed between the Contract Documents and the as-built conditions. Steel erection shall not start until corrective measures, if required, have been performed.

3.2 FABRICATION

A. Fabricate and assemble structural steel in the shop to the greatest extent possible.

B. Tolerances:

1. Conform to the tolerances of the AISC "Code of Standard Practice," compensate for the difference between the temperature at time of fabrication and the mean temperature in service.
2. Elevator shafts used for temporary hoists shall conform to the detailed requirements of the hoist manufacturer.

C. Holes: Holes shall be provided in members to permit connections to the work of other trades or contracts, and for passage through the member of work of other trades. All holes shall be accurately drilled or punched at right angles to the surface of the metal in accordance with AISC Specifications. Holes shall not be made or enlarged by burning. Burning or drifting unfair holes will not be permitted. Holes that must be enlarged shall be reamed. Drift pins will be allowed only to bring together the several parts for connection. Holes in base plates shall be drilled. Holes shall be clean-cut without torn or ragged edges. Outside burrs resulting from drilling operations shall be removed with a suitable tool.

D. Camber: Provide camber as indicated on the Contract Documents. Where no camber is indicated, provide natural camber up.

E. Cutting: Manual gas-cutting in the shop may be used only if automatic or semi-automatic methods are not possible. If manual shop cutting is required, it shall be done only with a mechanically guided torch, except that an unguided torch may be used where the cut is more than 1/2 inch (12mm) from the finished dimension and final removal is completed by means such as chipping or grinding to produce a gouge-free surface of quality equal to that of the base metal. At restrained joints and as indicated elsewhere, weld access holes shall be ground smooth.

F. Cutting of Heavy Shapes: Where Heavy Shapes are to be joined by partial or complete joint penetration welds in tension, preheating shall be required for all thermal cutting operations. Preheat shall be sufficient to prevent cracking but in no case less than 150 degrees F (65°C). Weld access holes and copes shall be ground to a smooth radius after cutting and tested for cracks by the magnetic particle method. All cut edges shall be free of sharp notches and gouges.

G. Anchor Rods: Rigid steel templates and anchor rods shall be furnished, labeled and shipped in sets indicating sizes and locations of columns, together with instructions for setting of anchor rods. Plate washers per Typical Details shall be provided.

H. Bolting: Bolts shall be driven accurately into the holes without damaging the threads. Bolt heads shall be protected from damage during driving. Bolt heads and nuts shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, beveled washers shall be provided to give full bearing under the head or nut.

I. Bolts indicated as “finger tight” on the Contract Documents shall be prevented from backing off by using lock nuts, thread compound or deformed threads.

J. Installation of High Strength Bolts:

1. Except where "snug tight" installation is specifically permitted on design Drawings, all high strength bolts shall be installed with full pretension using Turn-of-Nut Pretensioning, Twist-Off Type Tension Control Bolt Pretensioning or Direct-Tension-Indicator (DTI) Pretensioning in accordance with the "Specification for Structural Joints Using ASTM A325 or A490 Bolts".
2. Comply with special washer requirements of the RCSC, such as those related to slotted and oversize holes, and tapered flanges. DTI "washers" shall not be substituted for such required washers.
3. All high strength bolt assemblies (including Tension Control bolts and DTI’s) used in pretensioned connections shall be verified in accordance with the Pre-Installation Verification section of the RCSC.

4. Clean and re-lubricate bolts and nuts that become dry or rusty before use, except Tension Control bolts must be re-lubricated by manufacturer.

K. Welding of Structural Steel:
1. Pre-Weld Inspection: The surface to be welded and the filler material to be used shall be subject to inspection before welding is performed.
2. Welds indicated on the Contract Documents or the approved shop or erection drawings shall be created by electric arc welding processes that comply in all respects with the codes and specifications herein noted covering the design, fabrication, and inspection of welded structures and the qualifications of welders and supervisors. Control the heat input, weld length, weld sequence and cooling process to prevent distortion of the completed assembly.
3. Each welder's work shall be traceable.
4. Special Requirements: For High Restraint welds and welds at Heavy Shapes, follow approved welding procedures for weld process, sequence, pre-heating and cooling. Use stress relieving techniques where shown in the approved procedure developed by the Contractor's Welding Consultant.
   a) Special Procedures: Prior to the start of production welding, the contractor shall demonstrate to the Testing Agency that preheat can be maintained without relying on heat from the arc. For field welding, the contractor shall provide a shelter to protect each joint from inclement weather (rain, snow, etc.), from start until completion of the joint.
   b) Preheat and Postheat: Preheat shall be sufficient to prevent cracking, but in no case less than required by AWS D1.1. The Contractor shall prepare a written welding sequence and distortion control plan to be included in the welding procedures submittal. Assembly sequence of adjoining parts shall balance applied induced heat from preheat and welding processes to minimize distortion and shrinkage. Assemblies shall include special considerations to minimize significant shrinkage stress restraint in accordance with AWS D1.1, Annex H provisions. Under conditions of severe external shrinkage restraint, preheat temperature limitations for making welds shall be in accordance with AWS D1.1, Annex H, Table H2. Under conditions of severe external restraint, reduction of induced heat and cooling rate shall be monitored under the provisions of the Hydrogen Control/HAZ Hardness Control methods of AWS D1.1, Annex H. The preheat shall be maintained throughout the thickness of the material for a distance equal to twice the material thickness on both sides of the joint at a minimum. Where different thicknesses of steel are being joined, the greater thickness shall govern. Preheat shall be measured on the face opposite the side of the heat application. Preheat shall be applied uniformly in a manner that does not harm the surface of the material nor cause surface temperatures to exceed 1100 degrees F (600^{o}C). Should stress relief heat treatment be required, the contractor shall submit a written procedure.
   c) Prior to heat treatment on a production weld, prepare and treat a test sample per the Contractor's written procedure for tensile and Charpy V-notch tests in accordance with ASTM requirements.
5. Deficient Welds: Welds found deficient in dimensions but not in quality may be enlarged by additional welding. Any weld found deficient in quality shall be removed by grinding or melting and the weld shall be remade.

L. Bearing:
1. Bearing ends of columns shall be milled or sawn square perpendicular to axis of the column.
2. Finish bearing areas of base plates per AISC M2.8.

M. Stiffeners: Fitted stiffeners shall be ground to fit closely against flanges.

N. Cleaning and Preparation of Steel Surfaces:
1. Clean all steel work in accordance with the Society for Protective Coatings (SSPC) Method specified herein that corresponds to its location and exposure. Steel work to be painted shall be painted within the same day that it is cleaned.
   a) Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): SSPC-SP-2, Hand Tool Cleaning.
   b) Interior, Exposed in the Finished Building: SSPC-SP-6, Commercial Blast Cleaning, unless noted otherwise on the Drawings.
   c) Exterior (exposed to weather or in unconditioned space): SSPC-SP-6, Commercial Blast Cleaning, unless noted otherwise on the Drawings.
   d) Members to be Hot Dipped Galvanized: SSPC-SP3, Power Tool Cleaning, before galvanizing.

O. Shop Coating:
1. Where painting is specified, paint all steel work in accordance with the Society for Protective Coatings (SSPC) Method specified herein that corresponds to its location and exposure and in

accordance with manufacturer's written instructions. Paint steel work the same day that it is cleaned.

a) Interior, Not Exposed to View (above suspended ceilings, under sprayed-on fireproofing, steel to be encased in concrete): No Paint.
b) Interior, Exposed in the Finished Building: SSPC – Paint 25
c) Exterior (exposed to weather or in unconditioned space): SSPC – Paint 20

2. Protect finished bearing surfaces with a rust-inhibiting coating which is to be removed immediately prior to erection.
3. Do not paint:
   a) Surfaces within six (6) inches (150mm) of field welds
   b) Surfaces to be encased in concrete or to receive cementitious fireproofing
   c) Contact surfaces of high-strength bolted Slip Critical connections (unless surface prep and paint has been specifically prequalified by the contractor or approved for use in this location by the SER)
   d) Surfaces required for testing and preheat, until all testing and preheat has been performed
   e) Finished bearing surfaces (use removable rust-inhibiting coating)
   f) Top flange of the beam where steel deck or headed studs are to be attached
4. Paint shall be applied thoroughly and evenly to dry surfaces only when surface temperatures are above dew-point, in strict accordance with manufacturer's instructions.
5. Surfaces of exterior members which are inaccessible after assembly or erection shall receive their second coat of the approved paint, in a different shade, in the shop.
6. Hot-dip galvanize the following steel members:
   a) All angles, steel plates and shims supporting exterior masonry or exposed to the weather, including shelf, arch and relieving angles
   b) All connections between the above angles and steel plates and the supporting structural member, including clip angles and hardware
   c) Any other steel members indicated as “Galvanized” on the Contract Documents.
   d) All miscellaneous metal, angles, clips, etc. on exterior masonry walls.

3.3 ERECTION

A. Tolerances: Erect all work plumb, square and true to lines and levels in strict accordance with the structural requirements of the building within tolerances of the AISC Code of Standard Practice, unless otherwise indicated on the Contract Documents. Compensate for the difference between the temperature at time of erection and the mean temperature in service.
B. Bracing: Brace the frame during erection in accordance with the Contractor’s erection procedure.
C. Errors: Immediately notify the Design Professionals of any errors in shop fabrication, deformations resulting from handling and transportation, and improper erection that affects the assembly and fitting of parts. Prepare details for corrective work and obtain approval of the method of correction. Approved corrections shall be made expeditiously at the sole expense of the Contractor.
D. Column Base Plates: Support and align on steel shims or setting bolts. After the supported members have been plumbed and properly positioned, tighten anchor rod nuts in preparation for grouting. Cut off wedges and shims flush with edges of plates and leave in place. The use of leveling plates will not be permitted.
E. Grouting: Refer to General Notes. Grout base plates immediately after the first tier of columns are plumbed. Do not proceed with steel erection above the first tier until base plates are grouted.
F. Bolting and Welding of Structural Steel: See Section on "Fabrication".
G. Bearing Surface: Clean bearing surfaces and surfaces that will be in permanent contact before the members are assembled.
H. Splices: Splices will be permitted only where indicated on the Contract Drawings or the reviewed shop drawings. Fasten splices of compression members only after surfaces are cleaned and abutting surfaces have been brought completely into contact. Fill any remaining gaps with steel shims driven into place and cut flush. Tack weld shims to each other and to members. Use runoff tabs at bevel weld splices. Cut off runoff tabs and ground smooth after weld completion.
I. Driftpins: Driftpins may be used only to bring together the several parts, and shall not be used in such a manner as to distort or damage the metal. Correct poor matching of holes by drilling to the next larger size and using a larger size bolt. Plug welding and redrilling will not be permitted, unless a specific instance arises and is approved by the SER.
J. Erection bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces. On non-exposed welded construction, remove erection bolts.
K. Hammering: Hammering which may damage or distort the members will not be permitted.

L. Do not use cutting torches in the field without the specific approval of the SER for each application. Where cutting torch use is permitted, all the requirements of the Section on "Fabrication" shall apply.

M. Additional Material and Labor: If the Contractor furnishes additional material and labor for the purpose of erection or if the erection method requires that material be added to certain members, the required modifications shall be at the sole expense of the Contractor.

N. Alignment: Following erection, accurately align, level, and adjust all members prior to final fastening. Conform to AISC standard tolerances unless otherwise noted in the Contract Documents.

O. Touch-Up and Field Applied Paint: After erection, clean all damaged areas in the shop coat, exposed surfaces of bolts, bolt heads, nuts and washers and all field welds and unpainted areas adjacent to field welds according to manufacturers recommendations and paint with the same paint used for the shop coat. Match the touch up and field applied paint color to the as-built paint color. After touch up, at exterior (exposed to the weather or in unconditioned space) steel members apply a full coat of the specified paint in a different shade than the shop applied coat.

P. After erection, clean all damaged galvanized areas, welds and areas adjacent to welds and paint with the specified galvanizing repair paint.

Q. Clean all steel members of mud and debris and construction residue prior to erection.

R. Headed Studs and Deformed Bar Anchors:
   1. End weld headed studs and deformed bar anchors with an automatic process in accordance with section 7 of AWS D1.1.
   2. Areas to which studs are to be attached must be free of foreign material, such as rust, oil, grease, paint etc. When mill scale is sufficiently thick to cause difficulty in obtaining proper welds, remove by grinding or sand blasting.
   3. Remove ceramic ferrules from studs and work after welding.

S. Slide Bearings: Slide bearing plates shall be permanently affixed to member and support, respectively, by welding or bolting, as indicated. Member faces shall be aligned and leveled so as to maintain full and level contact between surfaces before completing installation. Use tapered shims where required for leveling.

3.4 CORRECTIVE MEASURES

A. Conflicts: The Contractor shall be solely responsible for errors of detailing, fabrication, and erection of structural steel, steel joists, and steel deck.

B. Compensation for Additional Services: Should additional work by Design Professionals such as design, documentation, meetings and/or site visits be required which are necessitated by failure of the Contractor to perform the work in accordance with the Contract Documents either developing corrective actions or reviewing corrective actions developed by others, the Contractor is responsible for paying for additional work performed by the Design Professionals at their standard firm-wide billing rates plus out-of-pocket expenses incurred at cost + 10%. Additional costs for testing and inspection by the Owner shall also be compensated by the Contractor.

Balance of page blank; see form on next page

Structural Substitution Request Form – to be completed by Contractor

Project:		
Date:		Substitution Request #
Requesting Contractor:		Pages Attached (including this form)

1. Description of Requested Substitution:

2. Related Drawings and Specification Sections:

3. Rationale or Benefit Anticipated:

4. Effect on Construction Schedule[1] (check one): ☐ NONE ☐ See Attached

5. Effect on Owner's Cost[2] attach data (check one): ☐ CREDIT TO OWNER ☐ EXTRA

6. Effect on Construction Documents[3] (design work anticipated): ☐ NONE ☐ See Attached

7. Requesting Contractor Agrees to Pay for Design Changes (check): ☐ YES ☐ NO ☐ NOT APPLICABLE

8. Effect on Other Trades[4]:

9. Effect of Substitution on Manufacturer's Warranty (check): ☐ NONE ☐ See Attachment

Signature[5]: Date:

Company:

General Contractor Signature[5]: Date:

Notes:

1. Contractor is responsible for means and methods and any problems that may arise from making the requested substitution.
2. This is **NOT A CHANGE ORDER FORM**. A separate form is required to adjust costs and/or schedules.
3. Contractor is responsible for any design impacts that may arise from this substitution, including redesign efforts.
4. Contractor is responsible for effects on other trades from this substitution; General Contractor must review and agree effects on other trades are fairly represented in items 4-9.
5. Signature by a person having authority to legally bind his/her company to the above terms. Otherwise this request is void
6. All items in form must be completed for substitution request to be considered.

Request Review Responses (completed by Architect and/or Engineer(s)):

ACCEPTED	ACCEPTED AS NOTED	REJECTED	INSUFFICIENT DATA TO SUPPORT REQUEST	ENGINEER / ARCH / MEP SIGNATURE	DATE

Engineer/Architect Comments:

END OF SECTION 051200

SECTION 053000 - STEEL DECK

PART 1 - GENERAL

1.1 GENERAL

Work of this Section shall conform to the requirements of Drawings and general provisions of the Contract, including General Conditions, Supplementary General Conditions and Division 1 Specification sections.

1.2 SCOPE

The work covered by this Section shall include all labor, material, equipment, permits, engineering and other services necessary for the design and installation of composite and non-composite structural steel floor deck systems, steel roof deck systems and related work with all attachments, flashings, metal closures, concrete stops, accessories and fittings as required for a complete installation in accordance with the Drawings and as specified herein.

1.3 RELATED WORK SPECIFIED IN OTHER SECTIONS:

Submittals	Division 1
Quality Control	Division 1
Concrete	Section 033000
Structural Steel	Section 051200
Miscellaneous Metals	Division 5
Fireproofing	Division 7
Painting	Division 9

1.4 CODES AND STANDARDS

A. Building Code: Steel deck work shall conform to the requirements of the Building Code identified on the Structural General Notes, and OSHA requirements, except where more stringent conditions or criteria occur in the standards referenced below and on the Drawings.

B. Standards:
1. All steel floor and roof deck manufacturers shall be listed in the Underwriter's Laboratories "Fire Resistance Index of Companies".
2. American Iron and Steel Institute (AISI) “Specification for the Design of Cold-Formed Steel Structural Members”.
3. American Welding Society AWS D1.3, “Structural Welding Code – Sheet Steel.”
4. American Society for Testing and Materials "ASTM Standards in Building Codes", various standards as referenced herein.
5. Steel Deck Institute (SDI) “Design Manual for Composite Decks, Form Decks and Roof Decks”.

C. Definitions:
1. See Section 051200.

1.5 STEEL DECK MANUFACTURER AND CONTRACTOR QUALIFICATIONS

A. The Manufacturer and the Steel Deck Erector (“Erector”) shall each demonstrate a minimum of ten (10) years of experience with the specified steel deck systems.

B. The Erector shall use prequalified welding processes in accordance with the AWS Structural Welding Code and shall provide certification that those welders to be employed in the Work are currently qualified for those processes and have satisfactorily passed the applicable AWS qualification tests.

C. Contractor’s Engineer shall be qualified to perform the type of work required by the project. The Engineer shall be a Professional Engineer licensed in the state where the project is located. The Contractor’s Engineer shall have 10 years of experience in responsible charge of work of this nature, on steel deck installations similar to this Project in material, design, and extent, with a record of successful in-service performance. Proposed Contractor’s Engineer shall be subject to approval of Design Professionals and Owner.

1.6 SUBMITTALS

A. Required Submittals - Where the SUBMITTALS section of this Specification is in conflict with Division 1 Submittals, the more stringent requirements for the Contractor apply. Required submittal items are listed here; see below for detailed requirements. Do not submit items not requested.
(1) Submittal Schedule
(2) Shop Drawings and Erection Drawings

(3) Manufacturer's Certification
(4) Manufacturer's Installation Instructions
(5) Welder Certifications
(6) Research Reports or Evaluation Reports

1. Submittal Schedule: The Steel Deck Contractor shall submit for action a schedule of drawing and calculation submissions at least twenty (20) working days prior to commencing submission of drawings and calculations. The schedule will indicate the number of drawings and calculations proposed to be submitted each week. Any modifications to the schedule shall be submitted for approval at least twenty (20) working days prior to modification is proposed to take place.
2. Shop Drawings and Erection Drawings (including Field Work Drawings): Submit for record manufacturers standard load tables and calculations for items designed by the Contractor's Engineer. Submit for approval shop drawings and erection drawings for all steel deck indicated on the Contract Documents.
   a) Materials shall not be fabricated or delivered to the site before the shop drawings have been approved or approved as noted by the Design Professionals and returned to the Contractor.
   b) Shop Drawings shall clearly indicate:
      i. Deck types (profiles), steel gauges, and deck finishes.
      ii. Deck layout, including panel locations, number of deck spans per panel, structural support locations and joint locations.
      iii. Deck dimensions and sections keyed to layout plans, including side and end details and bearing requirements.
      iv. Deck fastener types (welds, screws, pins, proprietary systems) and layout patterns at panel sides, ends and interior supports.
      v. Deck manufacturer, profiles, properties, vertical load capacity and in-plane diaphragm shear capacity for all as-detailed conditions.
      vi. Details and locations of accessories including hardware, framing reinforcement anchorage, sump pans, cant strips, ridge plates, valley plates and closure plates.
      vii. Fabrication necessary to incorporate steel deck into the job.
      viii. Correlation with other requirements, openings and flashings.
      ix. Fully dimensioned layout of field-installed headed studs (shear connectors).
      x. Contractor-coordinated openings for mechanical, electrical, plumbing, fire protection and other trades.
   c) A letter shall be submitted along with the shop drawings. It shall bear the registration number seal, signature and address of the Professional Engineer who prepared or supervised the calculation and reviewed the shop drawing submittal and shall include the following: "The steel deck calculations have been developed for this project and are designed by me, or by qualified personnel under my direct supervision, to resist the loads and reactions indicated on the Contract Documents. I have reviewed the steel deck layout drawings and they comply with assumptions used to develop the steel deck calculations."
   d) The Contractor shall have reviewed and approved the shop drawings prior to submission to the Design Professionals for their review, representing that the Contractor has verified all quantities, dimensions, specified performance criteria, installation requirements, materials, catalog number and similar data with respect thereto and reviewed or coordinated each drawing and sample with the work of other trades and with the requirements of the project and the Contract Documents.
3. Manufacturer's Certification: Submit for record a letter of certification from the deck manufacturer stating that the design, the detailing and fabrication of the steel deck to be installed under this Section are in accordance with the SDI Design Manual for Composite Decks, Form Decks and Roof Decks.
4. Manufacturer's Installation Instructions: Submit for record Manufacturer's literature providing recommended installation instructions.
5. Welder Certifications: Submit for record welder certificates signed by the Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.
6. Research or Evaluation Reports: Submit for record research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence steel deck's compliance with the building code in effect for the Project.

B. Submittal Process: See Section 051200
C. SER Submittal Review: See Section 051200
D. Substitution Request: See Section 051200
E. Request for Information (RFI): See Section 051200

1.7 COORDINATION AND TEMPORARY SUPPORT

A. Consult and cooperate with Contractors for other trades whose work affects or is affected by work under this Section in order that all phases of the work are properly coordinated to avoid delays, errors, omissions, or damage to any part of the work.

B. Steel Deck Contractor shall inform General Contractor of any special support requirements such as shoring of deck for wet concrete loads.

C. General Contractor shall coordinate with Steel Deck Contractor regarding any construction loads on deck before concreting, and on completed deck in excess of the design loads shown. Such conditions may include both gravity and lateral loads.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Do not bend or mar decking.

B. Store off ground with one end elevated for drainage.

C. Cover decking with waterproof material, ventilated to avoid condensation.

D. Do not store deck bundles on framing unless material is securely tied down and the framing has been analyzed to ensure that such storage will not cause an overload.

1.9 STRUCTURAL STEEL PRE-ERECTION CONFERENCE

See Section 051200

1.10 QUALITY ASSURANCE BY OWNER'S TESTING AGENCY

A. Owner's Testing & Inspection Agency:

1. Reports: The Testing Agency shall include in the daily reports of the structural steel, steel deck progress and description/area of work, tests made and results.
2. Coordination: The Contractor shall have sole responsibility for coordinating his work with the Testing Agency to assure that all test and inspection procedures required by the Contract Documents and/or Public Agencies, are properly provided. The Contractor shall cooperate fully with the Testing Agency in the performance of their work.
3. Cost: Except as specifically noted otherwise, the Testing Agency shall be engaged and paid by the Owner.

B. Decking is subject to inspection and testing once connected in place:

1. Expense of removing and replacing any portion of decking for testing purposes will be borne by the Owner if connections are found to be satisfactory.
2. Contractor shall remove work found to be defective and provide acceptable work at no additional cost to the Owner.

C. Field Inspection:

1. All steel deck shall be inspected after erection to ascertain the following relative to approved shop drawings:
   a) Deck profile, type (acoustic, cellular, vented), gage and finish
   b) Deck orientation, alignment, bearing and laps (if applicable)
   c) Supplementary items including secondary supports, closures, pour stops, sumps and their connections to deck and to other members
   d) Damage of members during transportation, storage and erection
   e) Installation for proper erection
   f) Connections (for quantity, size and spacing, and quality of welds) including inspection of deck welding
2. Headed studs (shear connectors):
   a) At the start of each day's operations for attaching headed studs, the Contractor shall first weld a minimum of two studs to demonstrate proper welding set up for that day's typical deck and support conditions. Testing Agency to observe Contractor hammer-bending the studs to an angle 15 degrees from the vertical without weld failure.
   b) Should failure occur in the weld zone of either stud, Contractor shall adjust welding set up and repeat the test until two consecutive studs are, tested and found satisfactory before any production welding of studs may begin.
   c) Perform demonstration tests at each significant change in conditions including deck thickness, deck coating (painted to galvanized) or number of deck layers.
   d) Do not weld studs through more than one layer of steel deck, except where cellular deck is specified.
   e) Failed test studs shall be removed and replaced by production studs.

f) During production installation, bend testing of headed studs is required where incomplete weld flash is observed, and at random locations on each floor. For production testing requirements see Section 051200.

D. Testing Agency Reports & Certifications:
1. Indicate to the Contractor where remedial work must be performed. Track and retest all locations of remedial work.
2. Upon completion of work and resolution of remedial items, certify in a letter to the Design Professionals and Owner that the installation is in accordance with the design and Specification requirements (including applicable codes).

1.11 QUALITY CONTROL BY CONTRACTOR
See Section 051200.

1.12 OBSERVATIONS AND CORRECTIONS BY DESIGN PROFESSIONALS
See Section 051200.

1.13 PERMITS AND WARRANTY
See Section 051200.

PART 2 - PRODUCTS

2.1 GENERAL
The work specified herein is based on the products of Vulcraft in order to establish design quality and function in the installed work. Products of other manufacturers shall be subject to the approval of the Design Professionals. All steel deck units shall be of the same depth and profile as shown on the Drawings and the product of one manufacturer.

2.2 DESIGN
A. Section properties of the steel deck units shall be calculated in accordance with the AISI “Specification for the Design of Cold-Formed Steel Structural Members”. The minimum positive and negative section moduli so obtained shall be used in calculations involving positive and negative moments, respectively, in determining the required gauges of steel deck units.
B. The Contractor’s Engineer shall be responsible for determining the suitability of single, double and multiple span lengths of decking for analysis under service and construction conditions.
C. Design of steel deck not receiving concrete fill:
1. Resist design loads using bare steel deck properties. Consider both construction loads and specified loads.
2. Use three span continuous layouts wherever possible.
D. Design of steel deck to receive concrete fill:
1. Design to work compositely with the concrete fill, unless otherwise specifically noted in the Contract Documents as ‘form deck.’
2. Assume deck acts with hardened concrete in a simple-span mode unless otherwise specifically noted on the Contract Documents.
3. Resist superimposed dead and live loads indicated on Drawings, but not less than 150 psf (7.5kPa) superimposed load on composite slab.
4. Resist construction loads using bare steel deck properties.
5. Assume unshored construction unless shoring is specifically coordinated with the General Contractor prior to design.
6. Use three span continuous layouts wherever possible.
E. At spans where trenches cross steel deck, design the interrupted deck ends as noncomposite cantilevers capable of supporting a superimposed dead and live load of 150 psf (7.5kPa) excluding concrete fill, unless greater load capacity is required by the Contract Documents. Increased deck gauge may be necessary to satisfy this loading condition.

2.3 MATERIALS
A. Prime Painted Cold Rolled Steel Sheet for deck and accessories: ASTM A1008 SS Grade 33 (minimum) with minimum yield strength of 33ksi (230MPa). Surface in contact with concrete (typically top) to be phosphatized. Exposed surface (typically bottom) to have oven cured gray or white lead- and chromate-free rust-inhibitive primer to 0.3 mil nominal dry film thickness.
B. Galvanized Steel: roof steel deck, floor galvanized steel deck and all closures and flashings shall be formed from steel sheets conforming to ASTM A653, Structural Quality Grade 33 (minimum) with

minimum yield strength of 33 ksi (230MPa). Before forming, the steel sheet shall be coated with a zinc coating conforming to ASTM A653 Zinc coated per ASTM A653 G60.

C. Floor decking shall be formed with integral locking lugs or embossments to provide a mechanical lock between the steel floor and the concrete slab sufficient to resist at least twice the design shear force. Minimum depth of embossments or locking lugs shall be .050"(1.3mm).

D. All steel decking shall be roll formed for uniformity in dimension and strength.

E. Floor and roof decking shall be classified by Underwriters' Laboratories, Inc. Each unit or bundle shall be labeled and marked as required by UL, indicating manufacturer, testing, and inspection.

2.4 ACCESSORIES

A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.

B. Side Lap Fasteners: Manufacturer's standard, corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 minimum diameter. Where Factory Mutual is indicated in the Contract Documents, fasteners must be approved by Factory Mutual as a method for securing steel roof deck for Class indicated.

C. Pour Stops and Girder Fillers: Steel sheet, of same material as deck panels, and of thickness and profile indicated, but not less than the deck gauge.

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

E. Hanger Tabs: Manufacturer's standard UL rated piercing steel sheet hanger attachment devices for floor deck panels.

F. Recessed Sump Pans: Manufacturer's standard size, single piece steel sheet 0.071-inch (1.8mm) thick minimum, of same material as deck panels, with 1-1/2-inch (40mm) minimum deep level recessed pans and 3-inch (75mm) wide flanges. Cut holes for drains in the field.

G. Flat Receiver Pan: Manufacturer's standard size, single-piece steel sheet, 0.071" (1.8mm) thick minimum units, of same material as deck panels.

H. Miscellaneous Roof Deck Accessories: Steel sheet ridge and valley plates, finish strips, and reinforcing channels, of same material and thickness as roof deck unless otherwise indicated.

I. Headed Studs (shear connectors) shall be per Structural General Notes.

J. Steel Sheet Accessories: ASTM A 653, galvanized to G 90 coating class.

K. Galvanizing Repair Paint: SSPC Paint 20 or MIL-P-21035, with dry film containing a minimum of 94% zinc dust by weight.

L. Flexible Rib Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

M. Sound-Absorbing Insulation: As required by the Contract Documents, provide manufacturer's standard premolded roll or strip glass fiber or mineral fiber.

2.5 SIDE JOINT HANGER SYSTEM FOR USE IN COMPOSITE STEEL FLOOR DECK ONLY

A. Provide hanger tabs along the side joints of units at 1'-0" (300mm) centers.

B. Side joint hanger tabs shall have a minimum allowable static load capacity of at least 100 lbs (45kg). and shall accommodate a flat bar hanger (no rod hangars).

C. All hangers, their installation, and tab activation shall be by trades requiring the tabs.

D. No plastered ceilings shall be hung from side joint hanger tabs.

E. No mechanical, electrical, plumbing or fire protection loads shall be hung from deck side joint hanger tabs.

2.6 MISCELLANEOUS MATERIALS

A. Arc-Welding Electrodes: AWS A5.1 E60XX or E70XX Series, as required for the conditions of use.

B. Touch Up Paint: use galvanized repair paint specified above.

C. Closure Tape as required to maintain cells clear of concrete at abutting panel ends.

PART 3 - EXECUTION

3.1 PREPARATION

A. Work by Others: Examine all work prepared by others to receive work of this Section, especially plan and elevation locations of supporting frames and walls. Report any defects affecting installation to Design Professionals. The Contractor alone shall be responsible for checking the dimensions and coordination of the steel deck work with other trades.

B. Do not place deck units on supports with debris or unapproved coatings that could affect full, level bearing and proper connections.

C. Do not place deck units on concrete supporting structures until concrete has cured and is dry.

D. Coordinate the location of decking bundles with a structural steel erector to prevent overloading of structural members.

3.2 ERECTION – PLACEMENT

A. Erect steel deck in accordance with the decking manufacturer's recommendations and the requirements of the Drawings and these Specifications.
B. Place steel deck on the supporting framework and adjust to final position with ends accurately aligned and bearing on supporting members before making permanent connections. Do not stretch or contract sidelap interlocks.
C. Place deck units flat, square, without warping or excessive deflections, in straight alignment for entire length of run of cells and with close alignment between the cells at ends of abutting units.
D. Abutting ends of deck panels shall occur over supports. End bearing shall be a minimum of 2 inches (50mm), or greater if required (web crippling) by deck manufacturer.
E. Where deck panels nest, laps shall be a minimum of 2" (50mm) and shall occur over supports. Nesting is permitted only where profiles are designed to nest and are fabricated with offset ends.
F. Install slab edge closures and pour stops at the theoretical position with maximum tolerance of + 3/8" (10mm). Closures and pour stops shall have adequate adjustments to maintain this tolerance while accommodating the structural steel frame tolerances.

3.3 ERECTION - CONNECTIONS

A. Connect steel deck to the steel framework at ends of units and at intermediate supports as shown on the Contract Documents and approved shop drawings.
B. Deck to support welds shall be puddle welds of diameter and spacing shown on Contract Documents and/or approved shop drawings.
C. Use welding washers for puddle welding at deck thinner than 22 gauge (0.85mm) and where recommended by the manufacturer
D. Where headed studs occur, if fused to deck for full weld perimeter each headed stud may be considered to replace one puddle weld
E. Fasten side laps and perimeter edges of panels between supports by button punching, side seam welding or screws, or as noted on Construction Drawings.

3.4 ERECTION – OPENINGS AND CLOSURES

A. Contractor to coordinate location of all openings with other trades (see Submittals).
B. Cut and install sleeves and holes through decking for openings indicated on the Architectural, Structural, and/or Mechanical-Electrical-Plumbing-Fire Protection Drawings. Cost shall be paid by the trade requiring such sleeves and holes. Sleeves will be furnished by the various trades requiring them. Provide and install reinforcement as required around sleeves. Where possible, leave deck intact and use block outs to hold back concrete at openings. Cut deck after concrete cures.
C. Provide miscellaneous headers and other steel reinforcing and supports welded to decking and structural steel as required at penetrations, around columns, etc. per typical details and manufacturer's recommendations.
D. Field cutting parallel to flutes shall be done in the low flutes, taking care to leave sufficient horizontal material to permit satisfactory welding of deck to supporting steel.
E. Openings required for work of other trades and not indicated on Architectural, Structural, Mechanical / Electrical / Plumbing / Fire Protection / Telecom Drawings shall be permitted only upon approval of the Design Professionals as to size and location.
F. Furnish and install tight-fitting closures at locations including but not limited to
    1. Open ends of flutes and sides of decking (neoprene or sheet steel)
    2. Open ends of all flutes at columns, walls and openings shown on Contract Drawings
    3. Panel ends where panels change direction or abut (sheet steel or closure tape)
    4. Between deck units and columns (sheet steel)
    5. Between columns and exterior cladding (sheet steel)
    6. Welding hole cover, with friction fastening, to close excess holes when required (sheet steel).

3.5 WELDING

A. Welding of steel deck shall follow the technique outlined by the steel deck manufacturer.
B. Welding of headed studs shall conform to all AWS requirements, including workmanship, quality control, and inspection, which shall be performed by the Contractor and observed by the Owner's testing agency.

3.6 ROOF SUMP PANS

Place over openings provided in roof decking and weld to top decking surface. Space welds not more than 12 inches (300mm) o.c. with at least one weld at each corner. Cut opening in roof sump bottom to accommodate drain size shown, coordinate with Plumbing Drawings.

3.7 CONCRETE PLACEMENT

A. Concrete with admixtures containing chloride salts or other deleterious materials shall not be used with steel deck.

B. Steel deck used to support concrete buggy runways shall be adequately protected against wheel damage. Decking and any runways or shoring shall be evaluated and designed by Contractor's Engineer.

3.8 TOUCH-UP

A. After installation touch-up welds on galvanized decking with specified galvanized repair paint to a dry film thickness of 2 mils, at all locations that will not receive concrete fill.

B. Touch-Up Painting: Where exposed to view, wire brush, clean, and paint scarred areas, welds, and rust spots on both surfaces of installed deck panels.

1. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
2. Where shop-painted surfaces are exposed in-service, apply touch-up paint to blend into adjacent surfaces.

3.9 CORRECTIVE MEASURES

A. Where the Contractor requests that the Design Professionals develop the corrective actions or review corrective actions developed by others, the Design Professional shall be compensated as outlined in Part 3 – CORRECTIVE MEASURES section of Specification 051200.

END OF SECTION 053000

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Plant Rail.
2. Steel Railings.
3. Bollards.
4. Hammock Posts.

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 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. Coordinate 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.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Cable and Fasteners.
2. Handrail brackets.
3. Nonshrink, nonmetallic grout, anchoring cement, paint products.

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

C. Samples for Initial Selection: For products involving selection of color, texture, or design.

D. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
   a. Show method of connection and finishing members at intersections.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Plant Rail: Provide custom fabrication as indicated on Drawings.

1. Cable: 7-by-19, 3/16-inch stainless steel cable, Type 304 with clear vinyl-coated casing.

2. Fasteners: 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.
   a. Steel Eye Bolt: Type 316 stainless steel with stainless heavy hex nut, ½-inch by 3-1/4 inch.
   b. Steel Jaw and Jaw Turnbuckle: ½-inch by 6-inch.

C. Steel Railings: Provide custom fabrication as indicated on Drawings.

D. Bollards: Provide custom fabrication as indicated on Drawings.

E. Hammock Posts: Provide custom fabrication as indicated on Drawings.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 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.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

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: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.4 STEEL RAILINGS

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Tubing: ASTM A500 (cold formed) or ASTM A513.

C. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

D. Plates, Shapes, and Bars: ASTM A36/A36M.

E. Cast Iron Fittings: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

2.5 POWDER COATING

A. Materials: All structural steel for the swing structure shall be powder coated following the structural steel being hot-dipped galvanized. Use powder coating consisting of an acrylic resin type with no vinyl or styrene modification. Provide a formulation that will not fade, yellow, or chalk within 10 years. Submit samples of acrylic powder material to the Engineer for approval.

B. Color: Landscape architect to select from full range of RAL colors. Basis of color to match Architectural steel.

C. Storage: Follow the Manufacturer's recommendations concerning handling and storage of materials.

D. Construction Methods: Follow the Manufacturer's recommended procedures.

1. Send hot-dipped galvanized parts to the coater without passivation (no dichromate top layer).

2. Brush blast the parts to remove oxidation and soils. Other methods of removal require approval by the Engineer. Wipe parts with a cleaning solvent to remove any oily residues. If the powder coating is not applied within 24 hours after cleaning, reclean the surface.

3. If required, pre-heat in accordance with powder coating manufacturer's recommendations.

4. Apply Acrylic Powder to minimum 4 mils to maximum 10 mils.

5. Fully cure powder coating per powder Manufacturer's recommendations.

6. After all coating has been sufficiently cured per recommendation of the Manufacturer, wrap all coated pieces in paper and cardboard for direct shipment to the job site.

7. Repair scratches incurred at the job site with a solvent-based acrylic paint or patch kit recommended by the manufacturer.

2.6 FASTENERS

A. Fastener Materials:

1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
3. Finish exposed fasteners to match appearance, including color and texture, of railings.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. 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.

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.

2.7 MISCELLANEOUS MATERIALS

A. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. 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.

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

2.8 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.

1. Clearly mark units for reassembly and coordinated installation.
2. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately.

1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
2. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water.

1. Provide weep holes where water may accumulate.
2. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for welds; good appearance, completely sanded joint, some undercutting and pinholes okay.

1. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

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 cap and end fittings of same metal and finish as railings.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.

1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
2. Coordinate anchorage devices with supporting structure.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Perform cutting, drilling, and fitting required for installing railings.

1. Fit exposed connections together to form tight, hairline joints.
2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
7. Install cable and fittings in accordance with Manufacturer's written instructions.

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

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

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

3.2 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.

3.3 ANCHORING POSTS

A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Leave anchorage joint exposed with anchoring material flush with adjacent surface.

3.4 ATTACHING RAILINGS

A. Secure wall brackets railings to site construction as follows:

1. For concrete anchorage, use drilled-in expansion shields and hanger or lag bolts.

3.5 CLEANING

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

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.

END OF SECTION 055213

SECTION 071326

BITUMINOUS 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, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Modified bituminous sheet waterproofing for below-grade walls.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference one-week before installation at Project Site.

1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Field quality-control reports.

C. Sample Warranties: For special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for installation.

1. Build for each typical waterproofing installation to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.

a. Size: 100 square feet in area.
b. Description: At below-grade cast-in-place concrete foundation walls.

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 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.8 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: 3 – 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Waterproofing System: Obtain waterproofing materials from single source from single manufacturer.

2.2 SELF-ADHERING SHEET WATERPROOFING

A. Modified Bituminous Sheet: Minimum 60-mil (1.5-mm) nominal thickness, self-adhering sheet consisting of 56 mils (1.4 mm) of rubberized asphalt laminated on one side to a 4-mil- (0.10-mm-) thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Carlisle Coatings & Waterproofing, Inc “CCW MiraDRI 860/861” or a comparable product by one of the following, as approved by Architect:

a. American Hydrotech, Inc.
b. CETCO, a Minerals Technologies company.
c. GCP Applied Technologies Inc. (formerly Grace Construction Products).
d. Henry Company.
e. MAPEI Corporation.
f. Polyguard Products, Inc.

2. Physical Properties:

a. Tensile Strength, Membrane: 250 psi (1.7 MPa) minimum; ASTM D 412, Die C, modified.
b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
c. Crack Cycling: Unaffected after 100 cycles of 1/8-inch (3-mm) movement; ASTM C 836/C 836M.
d. Puncture Resistance: 40 lbf (180 N) minimum; ASTM E 154/E 154M.
e. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F (21 deg C); ASTM D 570.
f. Water Vapor Permeance: 0.05 perm (2.9 ng/Pa x s x sq. m) maximum; ASTM E 96/E 96M, Water Method.
g. Hydrostatic-Head Resistance: 200 feet (60 m) minimum; ASTM D 5385.

3. Sheet Strips: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm), predrilled at 9-inch (229-mm) center, as recommended by manufacturer and approved by Architect.

G. Protection Course: As recommended by manufacturer.

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 waterproofing.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.

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

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing 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.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install sheet strips of width according to manufacturer's written instructions and center over treated construction and contraction joints and cracks as required.

F. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch (19-mm) fillets of liquid membrane on horizontal inside corners and as follows:

a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.

G. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and per recommendations in ASTM D 6135.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- (64-mm-) minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

1. When ambient and substrate temperatures range between 25 and 40 deg F (minus 4 and plus 5 deg C), install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F (16 deg C).

D. Two-Ply Application: Install sheets to form a membrane with lap widths not less than 50 percent of sheet widths, to provide a minimum of two thicknesses of sheet membrane over areas to receive waterproofing.

E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

F. Seal edges of sheet-waterproofing terminations with mastic.

G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches (150 mm) beyond repaired areas in all directions.

I. Immediately install protection course with butted joints over waterproofing membrane.

1. Refer to manufacturer recommendations and seek approval of Architect before utilizing any alternative product in place of a separate protection course to vertical applications.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests, as approved by Owner.

B. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.

C. Flood Testing: Flood test each deck area for leaks, according to procedures in ASTM D 5957, after completing waterproofing but before placing overlying construction. Install temporary containment assemblies, plug or dam drains, and flood with potable water.

1. Flood to an average depth of 2-1/2 inches (64 mm) with a minimum depth of 1 inch (25 mm) and a maximum depth of 4 inches (100 mm). Maintain 2 inches (51 mm) of clearance from top of sheet flashings.
2. Flood each area for 24 hours.
3. Testing agency shall observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.
4. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.

D. Waterproofing will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 PROTECTION, REPAIR, AND CLEANING

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION.

SECTION 072616

BELOW-GRADE VAPOR BARRIER

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. Pre-applied sheet membrane waterproofing that forms an integral bond to poured concrete, applied on prepared subbase prior to placement of concrete foundation slabs and walls.

1.3 SUBMITTALS

A. Submit manufacturer's product data, installation instructions and membrane samples for approval.

1.4 REFERENCE STANDARDS

A. The following standards and publications are applicable to the extent referenced in the text.

B. 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 903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
5. D 1434 Standard Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting
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

1.5 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 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.

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 in labeled packages. Store and handle in strict compliance with manufacturer's instructions. Protect from damage from weather, excessive temperature and construction operations. Remove and dispose of damaged material in accordance with applicable regulations.

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 used. Proceed with installation only when the substrate construction and preparation work is complete and in condition to receive sheet membrane waterproofing.

1.8 WARRANTY

A. Sheet Membrane Waterproofing: Provide written five year material warranty issued by the membrane manufacturer upon completion of work.

PART 2 - PRODUCTS

2.1 Materials

A. Pre-applied Integrally Bonded Sheet Waterproofing Membrane:
1. Basis of Design:
a. Preprufe® 200 Membrane by GCP Advanced Technologies Construction Products, a composite sheet membrane comprising 0.5 mm (0.020 in.) of high density polyethylene film, and layers of specially formulated synthetic adhesive layers.
2. Substitutions: Prior approved equal
3. 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
Film Thickness	ASTM D 3767 Method A	0.5 mm (0.020 in.) nominal
Low Temperature Flexibility	ASTM D 1970	Unaffected at -23°C (-10°F)
Elongation	ASTM D 412 Modified[1]	>300%
Crack Cycling at -23°C (-10°F), 100 Cycles	ASTM C 836	Unaffected
Tensile Strength, Film	ASTM D 412	27.6 MPa (4,000 lbs/in.^{2}) minimum
Peel Adhesion to Concrete	ASTM D 903 Modified[2]	880 N/m (5.0 lbs/in.)
Resistance to Hydrostatic Head	ASTM D 5385 Modified[3]	10 m (30 ft) minimum
Puncture Resistance	ASTM E 154	600 N (135 lbs) minimum
Permeance	ASTM E 96 Method B	<0.6 ng/m^{2}sPa (0.01 perms)
Water Absorption	ASTM D 570	<0.5%

4. Elongation of membrane is run at a rate of 50 mm (2 in.) per minute.
5. 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.

6. Hydrostatic head tests are performed by casting concrete against the membrane with a lap across a 1mm (0.040 in) crack.

B. Waterstop:
1. Basis of Design:
a. AdcorTM ES hydrophilic non-bentonite waterstop by GCP Advanced Technologies Construction Products for non-moving concrete construction joints.
2. Substitutions: Prior approved equal.

C. Miscellaneous Materials: Tape and other accessories specified or acceptable to manufacturer of pre-applied waterproofing membrane.

PART 3 - EXECUTION

3.1 EXECUTION

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 INSTALLATION, VERTICAL APPLICATIONS

A. Substrates shall be smooth and sound.
1. Substrates:
a. Basis of Design: Hydroduct® Drainage Composites by GCP Advanced Technologies Construction Products.
2. Substitutions: Plywood, or prior approved equal.

B. Strictly comply with installation instructions in manufacturer's published literature, including but not limited to, the following (as recommended by the basis of design product manufacturer):
1. Apply membrane with the HDPE film facing the prepared soil retention system (wood lagging, sheet piling, gunite, shotcrete, etc.). - Mechanically fasten the membrane vertically using fasteners appropriate to the substrate with the printed coated side facing towards the concrete pour. The membrane may be installed in any convenient length.
2. Secure the top of the membrane using a batten such as a termination bar or fixing 50mm (2 in.) below the top edge. Working downwards, fastenings should be made through the overlap area at maximum 0.5m (20 in) on center so that the membrane lays flat without openings. Immediately remove the plastic release liner.

3.3 INSTALLATION, HORIZONTAL APPLICATIONS

A. Earth and stone substrates shall be well compacted to produce an even, solid substrate. Remove loose aggregate or sharp protrusions. Concrete substrates shall be smooth or broom finished and monolithic. Fill gaps or voids greater than 13 mm (0.5 in.). Remove standing water prior to membrane applications.

B. Strictly comply with installation instructions in manufacturer's published literature, including but not limited to, the following (as recommended by the basis of design product manufacturer):
1. Apply membrane with the HDPE film facing the prepared substrate. Remove the release liner during application.
2. Accurately position succeeding sheets to overlap the previous sheet 75mm (3 in.) along the marked lap line. Ensure the membrane lays flat without any openings. End laps should be staggered to avoid a build up of layers.
3. Completely remove the plastic liner to expose the protective coating. Any initial tack will quickly disappear.
4. To prevent the membrane from moving and fishmouths opening, the laps should be fastened together at maximum 1.0m (39 in) on center. Fix through the center of the lap area using 12mm (0.5 in) long washer-head self-tapping screws or similar allowing the head of the screw to bed into the adhesive compound to self seal. It is not necessary to fix the membrane to the substrate, only to itself.
5. Ensure the membrane lays flat and no openings occur. Additional fastening may be required at corners, details etc.

3.4 PROTECTION

A. 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.

SECTION 074213.13
FLUSH METAL WALL / SOFFIT PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes complete system of concealed-fastener, lap-seam metal panels in the following applications:
   1. Metal wall panels.
   2. Metal soffit panels.

1.2 REFERENCES

A. Reference Standards:
   1. ASCE 7: Minimum Design Loads for Buildings and Other Structures.
   2. ASTM A653: Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.
   3. ASTM A792: Steel Sheet, 55 % Aluminum Zinc Alloy Coated by the Hot Dip Process.
   4. ASTM C1371: Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
   5. ASTM C1549: Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
   6. ASTM D523: Specular Gloss.
   7. ASTM E283: Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
   8. ASTM E331: Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
   9. ASTM E1592: Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
   10. ASTM E1918: Measuring Solar Reflectance of Horizontal and Low Sloped Surfaces in the Field.
   11. ASTM E1980: Calculating Solar Reflectance Index of Horizontal and Low Sloped Opaque Surfaces.
   12. CRRC-1 Method #1: Measuring Solar Reflectance of a Flat, Opaque, and Heterogeneous Surface Using a Portable Solar Reflectometer.
   13. SMACNA Architectural Sheet Metal Manual.

1.3 SUBMITTALS

A. Product Data.

B. Shop Drawings:
   1. Indicate thickness and dimensions of parts, fastenings and anchoring methods, details and locations of joints, transitions and other provisions necessary for thermal expansion and contraction.
   2. Indicate locations of field- and factory-applied sealant.

C. Samples:
   1. Submit two samples, 12 inches long by full panel width, showing proposed metal thickness and seam profile.
   2. Submit color samples of metal for Architect’s selection from manufacturer’s full range of colors.

D. Manufacturer Qualifications.

E. Installer Qualifications: Submit list of completed projects, with names and contact information for architects and contractors.

F. Test Reports: Indicating compliance of products with project requirements.

G. Warranty Documentation.

H. Insurance Documentation.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Ten years' experience, minimum, in factory fabrication of metal panels.

B. Installer Qualifications:
   1. Three years' experience, minimum, in application of metal roof or wall panels.
   2. Five satisfactory projects with metal panel work of similar scope and complexity to Work of this Project.

C. Testing Agency Qualifications: Agency compliant with ISO/IEC Standard 17025, or an accredited independent agency recognized by the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement or ANSI.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
   1. Keep panels and accessory items dry.
   2. Protect against damage and discoloration.
   3. Handle panels with non-marring slings.
   4. Support panels to prevent permanent deformation.
   5. Store panels above ground, with one end elevated for drainage.
   6. Protect panels against standing water and condensation between adjacent surfaces.
   7. If panels become wet, immediately separate sheets, wipe dry with clean cloth, and keep sheets separate for air-drying.
   8. Painted panels shall be shipped with protective plastic sheeting or a strippable film coating between panels. Remove strippable film coating prior to installation. Do not allow strippable film coating to remain on panels in extreme heat, cold, or direct sunlight or other UV source.

1.6 WARRANTY

A. Manufacturer's Warranty: Manufacturer’s standard 25-year performance warranty, stating the following:
   1. Architectural fluorocarbon finish:
      a. Will be free of fading or color change in excess of 5 Hunter delta-E units as determined by ASTM D2244-02.
      b. Will not chalk in excess of numerical rating of 8 when measured in accordance with standard procedures specified in ASTM D4214-98 method D659.
      c. Will not peel, crack, chip, or delaminae.
      d. Metal substrate will not rupture, fail structurally, or perforate.

B. Installer's Warranty: Warrant panels, flashings, sealants, fasteners and accessories against defective materials and/or workmanship, covering repairs required to maintain wall panels watertight and weatherproof with normal usage for two years following Project Substantial Completion date.
   1. Furnish written warranty, signed by installer.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Products: Provide on of the following
   1. Basis of Design: AEP Span, a Division of ASC Profiles; Flush Panel: www.aepspan.com or comparable by product by one of the following
      a. PAC Clad; Flush Solid Panel: www.pac-clad.com
      b. Bridger Steel, Flush Solid Panel: www.bridgersteel.com

B. Substitution Limitations: Prior approved equal.

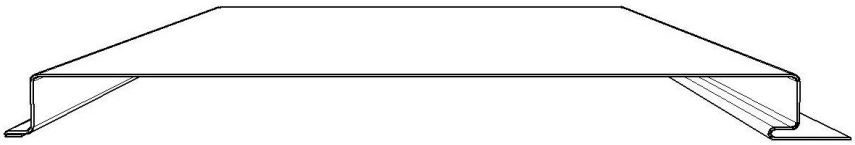
C. Performance Criteria
   1. Wind Uplift:

a. Panel system shall be ASTM E1592 tested under the supervision of an ANSI or ISO/IEC accredited laboratory and the laboratory shall issue the test report. Test data based on ASTM E330 is not acceptable.
b. Deflection Limits: Withstand wind loads with deflections no greater than 1/180 of the span.

2. Thermal Movements: Accommodate thermal movement without buckling, joint opening, failure of connections, or other detrimental effects, through the following temperature changes:
a. 120 degrees F, ambient.
b. 180 degrees F, surface.

2.2 PANELS

A. Panel:
1. Basis of Design: AEP Span, a Division of ASC Profiles; Flush Panel
2. Material: Steel conforming to ASTM A792.
a. 22 Gauge: Yield strength 50,000 psi; with aluminum-zinc alloy coating conforming to ASTM A792, Class AZ50.
3. Profile and Pattern: As scheduled.
Flush Panel, flat (no ribs or vents)



4. Finishes:
a. Exterior Panel Finish: Provide primer and finish coat on exposed faces; provide backer coat on concealed faces of panels. As recommended by manufacturer, or one of the options below:
1) DuraTech® 5000: Polyvinylidine Fluoride, full 70 percent Kynar 500/Hylar 5000, consisting of a baked-on 0.15-0.30 mil corrosion resistant primer and a baked-on 0.70-0.80 mil finish coat with a specular gloss of 8 to 15 when tested in accordance with ASTM D523 at 60 degrees.
2) Zincalume® Plus protective coating for unpainted aluminum-zinc alloy coating.
3) DuraTech® mx metallic finish, consisting of a baked-on primer 0.15-0.30 mil and a baked-on Polyvinylidine Fluoride finish coat 0.70-0.80 mil with a specular gloss of 15 to 25 when tested in accordance with ASTM D523 at 60 degrees.
4) DuraTech® Dimensional Prints: Polyvinylidine Fluoride, full 70 percent Kynar 500/Hylar 5000, consisting of a baked-on corrosion resistant primer and a baked-on finish coat with a dry film thickness of 1.10 to 1.40 mil and specular gloss of 15 to 30 when tested in accordance with ASTM D523 at 60 degrees.
5) Exterior Panel Color: to be selected by Architect from manufacturer's full range of colors.

5. Side lap Sealant: Factory apply sealant, except where no sealant is required. Field-applied sealant is not acceptable. Not recommended for soffit.

B. Sustainability Characteristics:
1. Solar Performance:
a. Solar reflective index (SRI): Not less than **22** per ASTM E1980.
b. Solar Reflectance: Not less than **0.25** per ASTM test methods C1549 or E1918, or CRRC-1 Method #1.
c. Thermal Emissivity: Not less than **0.75** per ASTM C1371.

2.3 FRAMING AND SUBSTRATES

A. Secondary Framing: See Section 05 40 00 "Cold-Formed Metal Framing".

B. Sheathing: See Section 06 16 00 "Sheathing".

2.4 ACCESSORIES

A. Trims and Flashings: Material, metal thickness, and finish to match panels. Profiles indicated in Drawings.

B. Panel Penetration Flashings: As recommended by panel manufacturer.

C. Fasteners: Per manufacturer recommendation.

D. Profile Closures: Polyethylene foam, die-cut or formed to panel configuration.

E. Sealant for Field Application: Per manufacturer recommendation.

2.5 FABRICATION

A. Fabrication, General:
1. Unless otherwise shown on Drawings or specified herein, fabricate panels in continuous lengths and fabricate flashings and accessories in longest practical lengths.
2. Panels shall be factory correctively-leveled.

B. Fabrication Tolerances:
1. Flat metal surfaces will display waviness commonly referred to as “oil canning”. This is caused by steel mill tolerances and is a characteristic, not a defect, of panels manufactured from light gauge metal. Panels are factory correctively-leveled to minimize the occurrence of “oil canning”. As such, “oil canning” will not be accepted as cause for rejection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: With Installer present.
1. Examine conditions and substrates on which metal panels are to be installed. Structural support or substrate shall be flat and plumb to avoid panel stresses and distortion.
2. Verify that air barrier work is complete and inspected.
3. Prior to starting work, correct defects.

B. Field Measurements:
1. Coordinate field measurements and fabrication schedule with construction progress.
2. Field measure prior to fabrication. Show recorded dimensions on shop drawings, including locations of shop-fabricated openings.
3. If field measurements differ from drawing dimensions, notify Architect prior to fabrication.

C. Substrate Tolerances: Deviations from flat plane shall not exceed the following.
1. Standard CMU installation tolerances

3.2 PREPARATION

A. Protection:
1. Treat contacting surfaces of dissimilar materials to prevent electrolytic corrosion.
2. Where panels or trim may come in contact with dissimilar materials or treated lumber, fabricate transitions to facilitate drainage and minimize possibility of galvanic corrosion.
3. At points of contact with dissimilar metal or treated lumber, coat panel or trim with protective paint or separate materials with a weatherproof underlayment.
4. Direct contact or run-off from CCA, ACQ, AC, or other treated lumber (outdoor wood) or fire retardant impregnated or treated wood shakes or siding can cause panels and trim to fail prematurely. Avoid contact with these materials.

3.3 INSTALLATION

A. Air Barrier on Substrate: Install according to approved shop drawings and metal panel manufacturer's recommendations.

B. Panels and Flashing:
1. Install according to approved shop drawings.
2. Comply with methods and recommendations of SMACNA Architectural Sheet Metal Manual for flashing configurations required.
3. Overlap flashing at least 6 inches.

4. Discrepancies between job site conditions and shop drawings shall be brought to the attention of the Architect for resolution.
5. Cutting and Fitting:
    a. Cut panels neat, square, and true with shearing action cutters. Torch or power saw cutting is prohibited.
    b. Openings 6 inches and larger: Shop fabricate and reinforce to maintain original load capacity.
    c. Openings less than 6 inches: Field cutting is acceptable.

C. Accessories: Install trims, panel closures, flashings according to Drawings and manufacturer's recommended details.

D. Sealant Installation: Apply according to approved shop drawings and SMACNA Architectural Sheet Metal Manual recommendations.

3.4 CLEANING

A. Repairs:
1. Touch up paint is not required for panels with scratches that do not expose metal.
2. Panels or flashings with finish damage exposing metal or with substrate damage shall be replaced.

B. Cleaning and Waste Management: At completion of each day’s work and at work completion, sweep panels, flashings, and gutters clean. Do not allow fasteners, cuttings, filings, or scraps to accumulate.

END OF SECTION.

SECTION 074623

WOOD SIDING / SOFFIT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Custom wood soffit, trim, and plates.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Division 07: Sheet Metal Flashing and Trim

1.2 SUBMITTALS

A. Submittals for Review:
   1. Samples: 12 inch long siding samples in each profile and species.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 5-years experience in work of this Section.

B. Mockups:
   1. Construct in-place mockups of 36” length of wood trim as indicated in drawings
   2. Construct in-place mockups of one bay of wood soffit as indicated in drawings.
   3. Approved mockups may remain as part of the Work.

1.4 PROJECT CONDITIONS

A. Do not install siding on wet or frozen substrate.

B. Do not install siding at temperatures below 40 degrees F.

PART 2 PRODUCTS

2.1 MATERIALS

A. Wood Soffit:
   1. Source, species, and profile: As scheduled at end of Section.
   2. Average moisture content: Maximum 12 percent.

B. Wood Trim
   1. Source, species, and profile: As scheduled at end of Section.
   2. Average moisture content: Maximum 12 percent.

C. Wood Plating
   1. Source, species, and profile: As scheduled at end of Section.
   2. Average moisture content: Maximum 12 percent.

2.2 ACCESSORIES

A. Fasteners: Type recommended by siding manufacturer; Series 300 stainless steel.

B. Sheet Metal Flashings and Trim: Specified in Section 07 6200.

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to installation, condition wood to average humidity that will prevail after installation.

B. Back prime siding and trim prior to installation.

3.2 INSTALLATION

A. Install siding in direction indicated, plumb and level, evenly spaced.

B. Butt end joints; fit tight.

C. Cut siding to fit at perimeter and around penetrations with maximum 1/8 inch gaps. Sand and prime paint seal cut edges.

D. Fasten at each support. or 16 inches on center maximum, per manufacturer recommendation.

E. Install metal flashings at internal and external corners, sills, and heads of wall openings. Fasten at 12 inches on center maximum.

3.3 SCHEDULE

A. Wood 1: Soffit
1. Description: Modular flush wood soffit with return and trim at perimeters, as indicated on Drawings and with concealed fasteners.
2. Species and finish: Teak Metro, Clear Finish.
3. Source: TerraMai (www.terramai.com)
4. Basis-of-Design: TerraMai 3D-Stick Modular Panel

B. Wood 2A: Wood Plate (at columns, as indicated on Drawings)
1. Description: Nominal wood, flush, installed as plate, at size indicated on Drawings, and with concealed fasteners.
2. Species and finish: To match Manufacturer, Species, and Finish of Wood 1.
3. Source: TerraMai (www.terramai.com)

C. Wood 2B: ¾” Wood Trim (as indicated on Drawings)
1. Description: Nominal wood, flush, installed as ¾” trim, at lengths and locations indicated on Drawings, and with concealed fasteners.
2. Species and finish: To match Manufacturer, Species, and Finish of Wood 1.
3. Source: TerraMai (www.terramai.com)

END OF SECTION.

SECTION 076200

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, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed low-slope roof sheet metal fabrications.
2. Formed equipment support flashing.

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 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. Certification Letter: ANSI SPRI ES1 for all roof termination metal.

C. Shop Drawings: For sheet metal flashing and trim.

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.

D. 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.

Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.

1.6 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 and FM Approvals approved, shop shall be listed as able to fabricate required details as tested and approved.

1.7 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.

1.8 WARRANTY

A. 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.

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. SPRI Wind Design Standard: Manufacture and install roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. 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. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:
   a. 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.
3. Color: As selected by Architect from manufacturer's full range.
4. 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.

2.3 UNDERLAYMENT MATERIALS

A. 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. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Ultra.
c. Henry Company; Blueskin PE200 HT.
d. Polyguard Products, Inc.; Deck Guard HT.
e. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, 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 Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.5 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, 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. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. 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.

E. 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.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.Rivet joints where necessary for strength.
K. Do not use graphite pencils to mark metal surfaces.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS
A. Roof Edge Flashing (Gravel Stop) and Fascia Cap, as indicated by drawings: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long sections. Furnish with 6-inch-wide, joint cover plates. Shop fabricate interior and exterior corners.
1. Joint Style: Butted with expansion space and 6-inch- wide, concealed backup plate.
2. Fabricate with scuppers spaced 10 feet apart, to dimensions required with 4-inch- wide flanges and base extending 4 inches beyond cannot or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
3. Fabricate from the Following Materials:
a. Galvanized Steel: 0.028 inch thick.
B. Base Flashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Galvanized Steel: 0.028 inch thick.
C. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:
1. Galvanized Steel: 0.022 inch thick.
D. Flashing Receivers: Fabricate from the following materials:
1. Galvanized Steel: 0.022 inch thick.
E. Roof-Penetration Flashing: Fabricate from the following materials:
1. Galvanized Steel: 0.028 inch thick.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS
A. Equipment Support Flashing: Fabricate from the following materials:
1. Galvanized Steel: 0.028 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 compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. 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 14 days.

3.3 INSTALLATION, GENERAL
A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, 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 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 and cover with slip sheet.

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 inchdeep, 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 079200 "Joint Sealants."

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing as indicated by Drawings: 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.

C. 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.

D. 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 snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.5 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.

3.6 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.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.7 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.

END OF SECTION.

SECTION 087100

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.
2. UL10C – Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 – Access Control System Units.
4. ULC-S319 - Electronic Access Control Systems.
5. ULC-60839-11-1, Alarm and Electronic Security Systems - Part 11-1: Electronic Access Control Systems - System and Components Requirements.
6. UL 305 – Panic Hardware.
7. ULC-S132, Emergency Exit and Emergency Fire Exit Hardware.
8. ULC-S533 – Egress Door Securing and Releasing Devices.
9. ANSI/UL 437- Key Locks.

10. ULC-S328, - Burglary Resistant Key Locks.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.
h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

D. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware 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.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Twenty five years for manual overhead door closer bodies.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

a. Basis of Design:
   1) McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).

b. Substitutions: Prior approved equal.

2.3 DOOR OPERATING TRIM

A. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Manufacturers:

   a. Basis of Design:
      1) Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

   b. Substitutions: Prior approved equal.

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
5. Keyway: Match Facility Standard.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. Existing System: Field verify and key cylinders to match Owner's existing system.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).

F. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Where specified, provide status indicators with highly reflective color and wording for “locked/unlocked” or “vacant/occupied” with custom wording options if required. Indicator to be located above the cylinder with the inside thumb-turn not blocking the visibility of the indicator status. Indicator window size to be a minimum of 2.1” x 0.6” with a curved design allowing a 180 degree viewing angle with protective covering to prevent tampering.

2. Manufacturers:

    1) Basis of Design:
        a) Corbin Russwin Hardware (RU) – ML2000 Series.
        b) Sargent Manufacturing (SA) – 8200 Series.
    2) Substitutions: Prior approved equal.

2.6 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.7 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.

4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Manufacturers:

a. Basis of Design:
   1) Corbin Russwin Hardware (RU) – DC8000 Series.
   2) Sargent Manufacturing (SA) – 281 Series.

b. Substitutions: Prior approved equal.

C. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Manufacturers:

a. Basis of Design:
   1) Corbin Russwin Hardware (RU) – DC6000 Series.
   2) Sargent Manufacturing (SA) – 351 Series.

b. Substitutions: Prior approved equal.

2.8 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:

   a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Manufacturers:

   a. Basis of Design:
      1) Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

   b. Substitutions: Prior approved equal.

2.9 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

   a. Basis of Design:
      1) Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).

   b. Substitutions: Prior approved equal.

2.10 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. Basis of Design:

a. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2. Substitutions: Prior approved equal.

2.11 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.12 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures” and “Cash Allowances”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.
2. Submit documentation of incomplete items in the following formats:

a. PDF electronic file.
b. Electronic formatted file integrated with the Openings Studio™ door opening management software platform.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality. Manufacturers provided are to be considered basis of design. Substitutions for products/manufacturers allowed with prior approval from Architect.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

B. Manufacturer’s Abbreviations:

1. MK - McKinney
2. SA - SARGENT
3. RO - Rockwood
4. PE - Pemko

Hardware Sets

Set: 1.0

Doors: 01A

3 Hinge (heavy weight)	T4A3386 NRP	US32D	MK
1 Storeroom Lock	8204 LNP x Facility Keying	US32D	SA
1 Door Closer	281 O SRI	EN	SA
1 Kick Plate	K1050 10" High x LDW CSK	US32D-MS	RO
1 Door Stop	406 / 409 / 446 as required	US32D	RO
1 Threshold	171A x Width		PE
1 Gasketing	2891APK (Head & Jambs)		PE
1 Sweep	315CN x Width		PE
1 Louver (top justified)	*to be coordinated with Mechanical for open area requirements.		

Set: 2.0

Doors: 01B, 01C

3 Hinge, Full Mortise	TA2314 NRP	US32D	MK
1 Storeroom Lock	8204 LNP x Facility Keying	US32D	SA
1 Door Closer w Positive Stop	281 PS SRI	EN	SA
1 Kick Plate	K1050 10" High x LDW CSK	US32D-MS	RO
1 Threshold	171A x Width		PE
1 Gasketing	S88D (Head & Jambs)		PE
1 Sweep	315CN x Width		PE
1 Louver (top justified)	*to be coordinated with Mechanical for open area requirements.		

Set: 3.0

Doors: 02A

3 Hinge (heavy weight)	T4A3386 NRP	US32D	MK
1 Storeroom Lock	8204 LNP x Facility Keying	US32D	SA
1 Door Closer	281 O SRI	EN	SA
1 Kick Plate	K1050 10" High x LDW CSK	US32D-MS	RO
1 Door Stop	406 / 409 / 446 as required	US32D	RO
1 Threshold	171A x Width		PE
1 Gasketing	2891APK (Head & Jambs)		PE
1 Sweep	315CN x Width		PE

Set: 4.0

Doors: 03C, 03D, 03E, 03F

3 Hinge, Full Mortise	TA2314 NRP	US32D	MK
1 Privacy Lock	LB 49 8265 LNP	US32D	SA
1 Foot Pull	FP1230	US32D-MS	RO
1 Surface Closer	351 O	EN	SA

1	Mop Plate	K1050 4" High x LDW CSK	US32D-MS	RO
1	Kick Plate	K1050 10" High x LDW CSK	US32D-MS	RO
1	Door Stop	406 / 409 / 446 as required	US32D	RO
3	Silencer	As req'd		RO
1	Coat Hook	RM820	US32D	RO

Set: 5.0

Doors: 03G

3	Hinge, Full Mortise	TA2314 NRP	US32D	MK
1	Storeroom Lock	8204 LNP x Facility Keying	US32D	SA
1	Surface Closer	351 O	EN	SA
1	Kick Plate	K1050 10" High x LDW CSK	US32D-MS	RO
1	Door Stop	406 / 409 / 446 as required	US32D	RO
3	Silencer	As req'd		RO

Set: 6.0

Doors: 03A, 03B

1	Note	Hardware by gate mfr - coordinate

Notes:

1. Refer to drawings for door sizes.
2. Design intent: custom-designed iron security gates with exterior-grade hardware including hinge, latch, lock with vertical pin in slab for hold-open and closed position. Refer to interior elevations for approximate design, including vertical pickets, and lower base mesh screen infill between vertical pickets.
3. Coordinate keying requirements.

END OF SECTION.

SECTION 089119

FIXED AIR INTAKE LOUVERS

PART 1 GENERAL

1.01 Summary

A. Furnish and install louvers, structural supports and attachment brackets as shown on the drawings, as specified, and as needed for a complete and proper installation.
B. The louvers to be furnished include the following:
    1. Standard fixed extruded louvers.
C. Related sections include:
    1. Division 7 Section "Joint Sealants" for sealants installed in perimeter joints between louver frames and adjoining construction.

1.02 References

A. Air Movement and Control Association International, Inc.
    1. AMCA Standard 500-L Laboratory Methods of Testing Louvers for Rating
    2. AMCA Publication 501 Application Manual for Louvers
B. The Aluminum Association Incorporated
    1. Aluminum Standards and Data
    2. Specifications and Guidelines for Aluminum Structures
C. American Society of Civil Engineers
    1. Minimum Design Loads for Buildings and Other Structures
D. American Society for Testing and Materials
    1. ASTM B209
    2. ASTM B211
    3. ASTM B221
    4. ASTM E90-90
E. Architectural Aluminum Manufacturers Association
    1. AAMA 800 Voluntary Specifications and Test Methods for Sealants
    2. AAMA 605.2 Voluntary Specification for High Performance Organic Coatings on Aluminum Extrusions and Panels.
    3. AAMA TIR Metal Curtain Wall Fasteners
    4. AAMA 2605-98 Superior Performing Organic Coatings on Aluminum Extrusions and Panels
F. Canadian Standards Association
    1. CAN3-S157-M83 Strength Design in Aluminum
    2. S136 94 Cold Formed Steel Structural Members

1.03 Submittals

A. Product Data
    1. Air flow and water entrainment performance test results.
    2. Material types and thickness.
B. Shop Drawings
    1. Include elevations, sections and specific details for each louver.
    2. Show anchorage details and connections for all component parts.
    3. Include signed and sealed structural calculations.
C. Samples
D. Submit color chips for approval.

1.04 Quality Assurance

A. Single subcontract responsibility: Subcontract the work to a single firm that has had not less than six years experience in the design and manufacturing of work similar to that shown and required.
B. Performance Requirements: Provide AMCA and BSRIA test data as required to confirm that the louvers have the specified air and water performance characteristics.
C. Structural Requirements: Design all materials to withstand wind and snow loads as required by the applicable building code. Maximum allowable deflection for the louver structural members to be l/180 or 0.75 inches,

whichever is less. Maximum allowable deflection for the louver blades to be l/120 or 0.50 inch across the weak axis, whichever is less.

D. Professional Engineer Requirements: Drawings and structural calculations to be signed and sealed by a professional engineer licensed to practice in the project state.
E. Warranty: Provide written warranty to the owner that all products will be free of defective materials or workmanship for a period of one year from date of installation.

1.05 Delivery, Storage and Handling

A. Delivery: At the time of delivery all materials shall be visually inspected for damage. Any damaged boxes, crates, louver sections, etc. shall be noted on the receiving ticket and immediately reported to the shipping company and the material manufacturer.
B. Storage:
    1. Material may be stored flat, on end or on its side.
    2. Material may be stored either indoors or outdoors.
    3. If stored outdoors the material must be raised sufficiently off the ground to prevent it being flooded.
    4. If stored out doors the material must be covered with a weather proof flame resistant sheeting or tarpaulin.
C. Handling:
    1. Material shall be handled in accordance with sound material handling practices and in such a way as to minimize racking.
    2. Louver sections may be hoisted by attaching straps to the jambs and lifting the section while it is in a vertical position.
    3. Louver sections should only be lifted and carried by the jambs. Heads, sills, base caps, end caps, and blades are not to be used for lifting or hoisting louver sections.

PART 2 PRODUCTS

2.01 Manufacturers

A. The louvers and related materials herein specified and indicated on the drawings shall be as manufactured by:
    1. Basis of Design: Construction Specialties A6080
    2. Substitutions: Prior Approved Equal
B. Products equal to the Basis of Design materials may be offered providing that the manufacturer and materials are pre-approved at least 10 working days before the bid date.

2.02 Materials

A. Aluminum Extrusions: ASTM B211, Alloy 6063-T5, 6063-T6 or 6061-T6.
B. Aluminum Sheet: ASTM B3209, Alloy 1100, 3003 or 5005.

2.03 Fabrication, General

A. Provide louver models, structural supports and accessories as specified and/or shown on the drawings, including end caps & base caps. Materials, sizes, depths, arrangements and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.
B. Louvers to be mechanically assembled using stainless steel or aluminum fasteners.
C. Include supports, anchorage, and accessories required for complete assembly.

2.04 Louver Models

A. 6” Deep High-Performance Fixed Extruded mullion Louver
    1. Material: Heads, sills, base caps, jambs, end caps, and mullions to be one piece structural aluminum members with integral caulking slot and retaining beads. Mullions shall be sliding interlock. Blades to be one piece aluminum extrusions with reinforcing boss. Material thickness to be as follows: Heads, sills, base caps, jambs, end caps, and mullions: 0.081” (2.06mm). Blades: 0.081” (2.06mm).
    2. AMCA Performance: A 4’ x 4’ unit shall conform to the following and be licensed to bear the AMCA seal:

Free Area	8.24 sq. ft. (0.765 sq. m.)
Free area velocity at the point of beginning water penetration	900 FPM (274 m/min)
Intake Pressure drop at the point of beginning water penetration	0.13 in. H_2O (3.38 mm)

Exhaust pressure drop at 1000 fpm free area velocity (305 m/min) 0.16 in. H_2O (4.06 mm)

2.05 Finishes

A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process. Provide color as indicated or, if not otherwise indicated, as selected and approved by architect.

B. 100% Fluoropolymer Resin Powder Coat System complying with AAMA-2605-5 standards for gloss and color retention. Finish thickness to be 1.5 to 3.0 mils.

1. Finish to allow zero VOCs to be emitted into facility of application or at job site.
2. Finish to adhere to a 4H Hardness rating.
3. Furnish manufacturer's twenty (20) year warranty for finish for gloss and color retention

OR

B. Three Coat Fluorocarbon Coating

1. Louvers to be finished with a minimum 1.4 mil (0.035mm) thick full strength 70% resin, 3 coat Fluoropolymer system.
2. All aluminum shall be thoroughly cleaned, etched and given a chromated conversion pre-treatment before application of the Kynar/Hylar coating. The coating shall consist of a primer, a high metallic color coat and a clear PVF2 topcoat. It shall receive a bake cycle of 17 minutes at 450°F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.
3. Manufacturer to furnish an extended 20 limited warranty for the Kynar/Hylar coating. This limited warranty shall begin on the date of material shipment.

OR

B. Two Coat Fluorocarbon Coating

1. Louvers to be finished with a minimum 1.0 mil (0.025mm) thick full strength 70% resin, 2 coat Fluoropolymer system.
2. All aluminum shall be thoroughly cleaned, etched and given a chromated conversion pre-treatment before application of the MICA II coating. The coating shall consist of a primer and a pearlescent pigmented PFV2 topcoat. It shall receive a bake cycle of 17 minutes at 450°F. All finishing procedures shall be one continuous operation in the plant of the manufacturer.
3. Manufacturer to furnish an extended 20 limited warranty for the Kynar/Hylar coating. This limited warranty shall begin on the date of material shipment.

OR

B. Clear Anodize

1. Louvers to be given a one hour 215R1 Architectural Class I anodic coating of 0.7 mil (0.018mm) thickness (Aluminum Association designation AA-C22A41).
2. The thickness of the coating shall be tested in accordance with ASTM B244-68.
3. The coating shall be sealed to pass the ASTM B136-77 Modified Dye Stain Test.

OR

B. Bronze Anodic

1. Louvers to be given a Bronze Anodic Architectural Class 1 coating of 0.7 mil (0.018mm) minimum thickness; and a minimum weight of 27 mg. per sq. in.
2. The thickness of the coating shall be tested in accordance with ASTM B244-68.
3. The coating shall be sealed to pass the ASTM B136-77 Modified Dye Stain Test.

PART 3 EXECUTION

3.01 Examination: Examine openings to receive the work. Do not proceed until any unsatisfactory conditions have been corrected.

3.02 Installation

A. Comply with manufacturer's instructions and recommendations for installation of the work.
B. Verify dimensions of supporting structure at the site by accurate field measurements so that the work will be accurately designed, fabricated and fitted to the structure.
C. Anchor louvers to the building substructure as indicated on architectural drawings.
D. Erection Tolerances:
    1. Maximum variation from plane or location shown on the approved shop drawings: 1/8" per 12 feet of length, but not exceeding 1/2" in any total building length or portion thereof (non-cumulative).
    2. Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 3": 1/16" (shop or field joints). This limiting condition shall prevail under both load and no load conditions.
E. Cut and trim component parts during erection only with the approval of the manufacturer or fabricator, and in accordance with his recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.
F. Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process as directed.
G. Set units level, plumb and true to line, with uniform joints.

3.03 Protection

A. Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

3.04 Adjusting and cleaning

A. Immediately clean exposed surfaces of the louvers to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.
B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.
C. Restore louvers and accessory components damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by the Architect, remove damaged materials and replace with new materials.
    1. Touch up minor abrasions in finishes with a compatible air-dried coating that matches the color and gloss of the factory applied coating.

END OF SECTION.

SECTION 095413

OPEN METAL MESH CEILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Section Includes

Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this Section

1.2 SUMMARY

A. SECTION INCLUDES

1. Exterior-rated, open metal mesh ceiling panels
2. Exposed grid suspension system
3. Wire hangers, fasteners, main runners, cross tees, and wall angle moldings
4. Perimeter Trim

B. ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
2. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
3. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
4. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
5. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

B. International Building Code

C. ASHRAE Standard 62 1 2004 Ventilation for Acceptable Indoor Air Quality

D. NFPA 70 National Electrical Code

E. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures

1.4 SYSTEM DESCRIPTION

Continuous/Wall-to-Wall

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.

B. Samples: Minimum 6 inch x 6 inch samples of specified panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.

C. Shop Drawings: Layout and details of ceilings show locations of items that are to be coordinated with, or supported by the ceilings.

D. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.

1.6 SUSTAINABLE MATERIALS

1. Transparency: Manufacturers will be given preference when they provide documentation to support sustainable requirements for the following: Material ingredient transparency, Removal of Red List Ingredients per LBCV3, Life Cycle impact information, Low-Emitting Materials, and Clean Air performance.

2. Low Emitting products with VOC emissions data. Preference will also be given to manufacturers that can provide emissions data showing their products meet CDHP Standard Method v1.1 (Section 01350).

1.7 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.

a. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 Classification.

C. Metal Mesh Panels: As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

D. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing ceiling units, permit them to reach room temperature and a stabilized moisture content.

C. Handle ceiling units carefully to avoid chipping edges or damaged units in any way.

1.9 PROJECT CONDITIONS

A. Space Enclosure: Non-conditioned Interior space, exposed to exterior environment

Building areas to receive ceilings shall be free of construction dust and debris. Products with hot dipped galvanized steel, aluminum or stainless steel suspension systems can be installed up to 120°F (49°C) and in spaces before the building is enclosed, where HVAC systems are cycled or not operating. Cannot be used in exterior applications where standing water is present or where moisture will come in direct contact with the ceiling.

1.11 WARRANTY

A. Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Panels: Sagging and warping

2. Grid System: Rusting and manufacturer's defects

B. Warranty Period:

1. Metal mesh panels: One (1) year from date of substantial completion

2. Grid: Ten (10) years from date of substantial completion

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.12 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.

1. Metal Ceiling Units: Furnish quality of full-size units equal to 5.0 percent of amount installed.

2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Metal Mesh Ceiling Panels, Suspension System, and Trim Accessories:

1. Basis-of-Design: Armstrong World Industries, Inc. MetalWorks Mesh, MetalWorks Trim & Accessories with Prelude XL 15/16” Exposed Tee

A. Open area of 70-80%

B. Metal finish, painted black. Exterior-rated. As recommended by manufacturer and approved by Architect.

2. Substitutions: Prior approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of ceiling metal mesh panel units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

B. Coordination: Furnish layouts for trim, preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.3 INSTALLATION

A. Follow manufacturer installation instructions and layout as designated by drawings, approved by Architect.

B. Install suspension system and panels in accordance with the manufacturer's instructions, and in compliance with ASTM C 636 and with the authorities having jurisdiction.

C. Install wall moldings at intersection of suspended ceiling as required by manufacturer. Miter corners where wall moldings intersect or install corner caps.

D. For reveal edge panels: Cut and reveal or rabbet edges of ceiling panels at border areas and vertical surfaces.

E. Install panels in coordination with suspended system, with edges resting on flanges of main runner and cross tees. Cut and fit panels neatly against abutting surfaces. Support edges by wall moldings.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION.

SECTION 099113

EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: General and Supplementary Conditions of the Contract, Division 01 General Requirements, and Drawings are applicable to this Section.

B. Section Includes:

1. Complete surface preparation and finishing for field application of coatings and requirements for field finishing mechanical and electrical equipment.
2. Examine specifications for various other trades and their provisions regarding their painting. Surfaces that are left unfinished by other sections of the specifications shall be painted or finished as a part of this Section.
3. Colors, including deep tones, will be selected by the Architect. Number of colors to be used on job will be determined by Architect.

1.2 SURFACES NOT TO RECEIVE FIELD FINISHING

A. Do not paint copper, bronze, chrome plated items, nickel, stainless steel, Monel metal, lead, face brick, prefinished wall, ceiling, and floor coverings, items with factory applied final finish (except where exposed on roofs and in finished spaces), chases, and plenums above suspended ceilings unless otherwise specified or scheduled.

1.3 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.4 QUALITY ASSURANCE

A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with 3 years of experience.

B. Applicator: Company specializing in commercial painting and finishing with 2 years of experience.

C. Product Labels: Include manufacturer's name, type of paint, stock number, color and label analysis on label of containers.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable building code for flame spread/fuel contribution/smoke development rating requirements for finishes.

B. Comply with applicable city, county, state, and federal requirements and ordinances regarding maximum VOC (Volatile Organic Compound) content of all coatings.

1.6 TESTS

A. Provide periodic testing with Wet Film Thickness gage to verify that proper thickness of finish coatings are being applied.

1.7 SUBMITTALS

A. Provide product data describing physical performance criteria and composition on all finishing products.

B. Submit 2 samples, 4 by 4 inches in size illustrating range of colors and textures selected for each surface finishing product scheduled.

C. Submit certification from manufacturer of coatings listing all products proposed for each. Certify that each product meets current applicable regulations and ordinances regarding maximum VOC content.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and protect products under provisions of Division 01 section “Product Requirements”

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.

C. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.

D. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well-ventilated area, unless required otherwise by manufacturer's instructions.

E. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the ranges required by paint manufacturer.

B. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.

C. Do not apply exterior coatings during rain or snow, or when relative humidity is above 75 percent, unless required otherwise by manufacturer's instructions.

D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.

E. Minimum Application Temperature for Varnish and Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

F. Provide lighting level of 80 ft candles measured mid- height at substrate surface.

1.10 EXTRA STOCK

A. Provide a 5 gallon container of each color to Owner.

B. Label each container with color, color number, texture, and room locations, in addition to the manufacturer's label.

C. Furnish under provisions of Section 017800.

1.11 SCAFFOLDS AND PROTECTION

A. Provide adequate safe ladders, scaffolds, and stages necessary to complete work.

B. Protect completed finish and paint work, and protect adjacent finish surfaces from paint splatter, spills and stains. Use adequate drop cloths and masking procedures during progress of work.

1.12 PRECAUTIONS

A. Do not store paints, oils, thinners and other flammable items inside the building and shall be stored in approved containers when not in actual use during the painting job. The fire hazard shall be kept at a minimum.

B. Precaution shall be taken to protect the public and construction workers during the progress of the work.

C. Furnish a temporary fire extinguisher of suitable chemicals and capacity, located near flammable materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements indicated, provide products of one of the following:

1. Tnemec.
2. Sherwin-Williams.
3. P.P.G. Industries.
4. Benjamin Moore.

B. Materials selected for coating systems for each type surface shall be product of a single manufacturer unless otherwise specified. Secondary products such as linseed oil, turpentine and shellacs shall be first quality products of a reputable manufacturer.

C. Products specified in Schedule are those of Glidden Professional as a standard of quality unless otherwise noted.

2.2 MATERIALS

A. Coatings: Ready mixed. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating with good flow and brushing properties; capable of drying or curing free of streaks or sags.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

C. Patching Materials: Latex filler.

2.3 FINISHES

A. Color and Finish (sheen): As approved by architect.

2.4 EXTERIOR PAINT SCHEDULE

A. Drywall (Gypsum) Ceiling (at chemical closet, as indicated by Drawings):

1. Acrylic Exterior-Grade Latex, appropriate for application as recommended by Manufacturer:
    a. Basis of Design:

1) Glidden: 1 coat Glidden Professional PVA Wall 1030 primer, 2 coats Glidden Professional Ultra-Hide 250.
2) Sherwin-Williams: 1 coat High Build Latex Primer B28W8601, 2 coats Sherwin-Williams ProMar 200 Zero VOC.

b. Substitutions: Prior approved equal.
c. Verify application with manufacturer.
d. Color/finish to be approved by Architect.

B. Metal Trim and Metal Doors:
1. Acrylic Latex, as recommended by door manufacturer.
a. Basis of Design:
1) Glidden: 1 coat Devoe Coatings DEVFLEX Direct-to-Metal 4020 primer: Semi-Gloss: 2 coats Glidden Professional Ultra-Hide 250 1406 topcoat.
2) Sherwin-Williams: 1 coat Sherwin-Williams DTM Primer/Finish B66W1: Semi-Gloss 2 coats Sherwin-Williams ProMar 200 Zero VOC Semi-Gloss B31-2600 Series topcoat.
b. Substitutions: Prior approved equal.
c. Verify application with door manufacturer.
d. Color/finish to be approved and scheduled by Architect.

C. Structural Iron and Ferrous Steel:
1. High Performance Coating System
a. Basis of Design:
1) Surface Preparation: SSPC-SP6 Commercial Blast Cleaning. Anchor profile shall be angular with a 1.5 to 2.0 mils as per ASTM D 4417, Method C or NACE Standard RP0287.
2) 3-Coat System:
- Prime Coat: Tnemec Series 90G-1K97 Tneme-Zinc applied at 2.5-3.5 dry mils
- First Coat: Tnemec Series 73 Endura-Shield applied at 3.0-5.0 mils
- Second Coat: Tnemec Series 1070 Fluoronar applied at 2.0-3.0 dry mils. For semi-gloss finish, use Series 1071. For satin finish, use Series 1072.

b. Substitutions: Prior approved equal.
c. Verify application with manufacturer.
d. Color/finish to be approved and scheduled by Architect.

D. Chalkable Surface Coating

Coordinate with Architect and flush metal panel wall product manufacturer for approval.
a. Basis of Design
1.) Tnemec Series 66 Epoxy
b. Substitutions: Prior approved equal.
c. Verify application with manufacturer. Samples to be tested and approved by Architect and flush metal panel wall product manufacturer before application.
d. Color/finish to be approved and scheduled by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.
B. Examine surfaces scheduled to be finished prior to commencement of work. Report to Architect any condition that may potentially affect proper application.
C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
1. Gypsum Wallboard: 12 percent.
D. Test shop applied primers for compatibility with subsequent cover materials.
E. Beginning of installation means acceptance of existing surfaces and substrate.

3.2 PREPARATION
A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
B. Correct minor defects and clean surfaces which affect work of this Section. Remove existing coatings which exhibit loose surface defects.
C. Shellac and seal marks which may bleed through surface finishes.
D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

E. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
F. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.
G. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
H. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
I. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
J. Shop Finished Items: Finish in accordance with AWI standards and guide lines.
K. Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.3 PROTECTION

A. Protect elements surrounding the work of this Section from damage or disfiguration.
B. Repair damage to other surfaces caused by work of this Section.
C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
D. Remove empty paint containers from site.

3.4 APPLICATION

A. The intent of these Specifications is to produce the highest quality appearance of paint and finish surfaces. Employ skilled mechanics only. The proper preparation of all surfaces will be strictly enforced and wherever finished surfaces show any defects due to improper preparation, workmanship, etc., the defects shall be removed and the work refinished at the expense of the Contractor.
B. Apply products in accordance with manufacturer's instructions. Final finish coats shall have visual evidence of solid hiding and uniform appearance, and shall be free and smooth of brush marks, streaks, sags, runs, laps, or skipped areas.
C. Do not apply finishes to surfaces that are not dry.
D. Apply each coat to uniform finish and thickness.
E. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
F. Sand lightly between coats on wood and metal items to achieve required finish.
G. Allow applied coat to dry before next coat is applied.
H. Edges of paint adjoining other materials or colors shall be sharp and clean with no overlapping.

3.5 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Paint any grilles, registers, diffusers, and speaker grilles to match adjacent surfaces, only as indicated on Drawings.
B. Repair or replace identification markings on mechanical or electrical equipment when painted accidentally.
C. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.

3.6 CLEANING/TOUCH-UP

A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.
B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.
D. Spot painting will be allowed to correct soiled or damaged paint surfaces only when touch-up spot will blend into surrounding finish and is invisible to normal viewing (as determined by the Architect). Otherwise, re-coat entire section to corners or to a visible stopping point.

3.7 V.O.C. (VOLATILE ORGANIC COMPOUND) COMPLIANCE

A. Products listed in following schedule and/or substitutes proposed for use by Contractor must be formulated to meet all applicable ordinances and regulations regarding maximum V.O.C. content. Utilize products which have been specially formulated to meet such requirements.

END OF SECTION.

SECTION 099623

GRAFFITI-RESISTANT COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Permanent anti-graffiti coating system.

B. Related Sections:
Section 04 22 00 – Concrete Unit Masonry: Substrate for application of Anti-Graffiti Coating.

1.2 QUALITY ASSURANCE

A. Contractor Qualifications: Installer shall be a firm with not less than three years of successful experience in application of coatings of type required on substrates similar to those of this project. The firm shall be approved by the manufacturer of the coating for installation of their product.

B. Manufacturer's representative shall inspect substrate conditions including alkalinity and moisture content. Obtain written approval from representative before proceeding with work.

C. Meets ASTM-D7089 with Cleanability at least Level 2.

D. Meets ASTM-D6578 with Cleanability at least Level 9.

1.3 SUBMITTALS

A. Submit in accordance with Section 01 33 00.

B. Instructions: Provide instructions bearing manufacturer's name, coating type, and recommended installation procedures. Provide methods and material instruction for graffiti removal. Include adhesive-backed graffiti removal instruction label suitable for application to interior surface (not to be applied to any guest-facing surfaces within the building.)

C. Submit proof of purchase (Invoice of materials purchased) and proof of delivery of coating materials.

D. Manufacturer’s Warranty: Submit one copy of manufacturer's warranty for specified materials.

E. Field Sample: Apply graffiti resistant coating to field mock-up sample representing exterior wall surface to be coated. Apply coating system over a minimum 3 ft x 3 ft test area and test removal of applied spray paint in presence of Construction Manager for approval using removal methods recommended by the manufacturer.

1.4 EXTRA MATERIALS

A. Furnish the following to building owner upon completion of the Project.

1. Provide four containers of removal products as recommended by the manufacturer accompanied by removal instructions.

1.5 DELIVERY, STORAGE AND HANDLING

A. Product Requirements: Transport, handle, store, and protect products.

B. Paint orders to the manufacturer or supplier shall identify the store number, location, and address of project. Contractor shall require a record keeping account be established and maintained by the paint supplier which records graffiti resistant paint type, brand, and quantity purchased, for the specific project.

C. Deliver coating materials in sealed original labeled containers, bearing manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for

mixing and/or reducing.

D. Store materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F in ventilated area and as required by manufacturer's instructions.

E. Prevent fire hazards and spontaneous combustion.

1.6 WARRANTY

A. Provide manufacturers written warranty guaranteeing effective graffiti removal for not less than 1 year and warrant that treated surfaces can be effectively and repeatedly cleaned of graffiti without damage or loss of effectiveness of the graffiti resistant coating. Manufacturer shall, for the duration of the warranty period, guarantee replacement of product and labor to remove graffiti and replace graffiti resistant coating where graffiti removal has shown to be ineffective.

1.7 PROJECT CONDITIONS

A. Environmental Requirements: Follow manufacturer's recommendations for temperature range in which coating may be applied.

PART 2 - PRODUCTS

2.1 GRAFFITI RESISTANT COATING

A. Graffiti resistant coating shall be a clear, non-sacrificial graffiti resistant coating which provides protection for exterior vertical surfaces from permanent graffiti staining and damage caused by spray paint and marking pens. Coating shall be suitable for application to painted and unpainted surfaces including masonry, concrete, metals, and EIFS. Product shall be of type such that recoating with the underlying paint is possible without removal of the graffiti resistant coating. Product shall be a coating that dries clear, non-yellowing, with a low luster.

1. Manufacturer:

a. Primary Coating
1) Basis of Design: VandlGuardONE Non-Sacrificial Graffiti Coating by Rainguard International, Newport Beach, CA 888-765-7070.
2) Substitutions: Prior-Approved Equal.

b. Water Repellant:
1) Basis of Design: Rainguard International Micro-Seal Water Repellant.
2) Substitutions: Prior-Approved Equal.

c. Graffiti Remover:
1) Basis of Design: VandlClean Super graffiti remover by Rainguard International, Newport Beach, CA 888-765-7070.
2) Substitutions: Prior-Approved Equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify all surfaces are ready to receive coating in accordance with manufacturer’s printed requirements. Beginning of installation indicates acceptance of substrate.

B. Unpainted Concrete and Masonry: Verify water repellant has been applied in accordance to manufacturer’s recommendations.

3.2 PREPARATION

A. Surface shall be free of dirt, dust, contaminants such as curing compounds, hardeners, bond breakers, and form release. Allow painted surfaces to cure properly. Do not water blast painted surfaces. Assure surfaces are clean and dry.

B. Mask or otherwise protect adjacent surfaces not scheduled to receive coating. If applied on unscheduled surfaces such as glass, remove immediately, by approved method.

C. Protect landscaping, property, and vehicles from over spray and drift.

3.3 APPLICATION

A. Apply coating in accordance with manufacturer's published instructions.

B. Application Rate: Apply each coat at the manufacturers published application rate.

3.4 SURFACES TO BE COATED

A. Apply graffiti resistant coating to all exterior and interior exposed CMU accessible to public, as specified by Architect.

3.5 MAINTENANCE

A. Deliver cleaning products to Store Manager for storage and subsequent use for graffiti removal. Apply cleaning instructions label to interior wall location as directed by the Construction Manager.

3.6 FIELD QUALITY CONTROL:

A. Verify application rate by periodic on-site inspection and calculation of area covered compared to consumption of coating material used. Document inspections showing total area covered and number and volume of coating containers used.

END OF SECTION.

SECTION 101400

SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Provisions established in Conditions of the Contract, Division 01 - General Requirements, and the Drawings are collectively applicable to this Section.

B. Section Includes

1. Identifying devices where shown on the Drawings complete and as specified including the following:
   a. Pin mounted, dimensional letter building identification signs.
   b. Interior code required tactile signage.

1.2 SUBMITTALS

A. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.

B. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, accessories, layout, and installation details.

C. Samples for Verification:

1. Physical: Submit samples of one competed sign for review and approval. Approved sample may be incorporated into Project.
2. Color: Submit manufacturer's standard color selection chart. Do not proceed until colors have been selected.

1.3 QUALITY ASSURANCE

A. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.

B. Manufacturer shall have a minimum of five years' experience in the manufacturing of signs specified.

C. Codes and Standards:

1. Panel signs shall have 1/32-inch raised copy and grade 2 Braille, and shall comply with all existing federal, state, and local accessibility standards.
2. Code and Standards: Comply with American with Disabilities Act of 1990, Title 3 Provisions, Public Accommodations and Commercial Facilities. Updated March 15, 2012.
3. Comply with the State of Texas Accessibility Standards, 2012 edition, as administered by the Texas Department of Licensing and Regulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following:

1. APCO Signs
2. Best Manufacturing Company
3. Mohawk Sign Systems
4. Nelson-Harkins
5. ASI Signs

B. Substitutions: Under provisions of Section 012500.

2.2 BUILDING IDENTIFICATION DIMENSIONAL LETTER SIGNAGE

A. Acceptable Manufacturers:

1. Basis of Design: ASI Sign Systems, 3890 W. Northwest Highway, Suite 102, Dallas, TX 75220; (214) 352 9140 telephone; (214) 352 9741 facsimile; (800) ASI-SPEC (274-7446).
2. Substitutions: Submit in accordance with Section 01600.

B. Acceptable Product: ASI Series LC Cast Metal Dimensional Letters.

C. Material:

1. Cast Aluminum in Satin Anodized finish.

D. Fabricated Dimensional Letters:

1. Letter Style: Refer to Drawings.
2. Letter Cap Height: Refer to Drawings.
3. Letter Depth: 1 inch.
4. Finish: As directed by Architect.

E. Mounting Method: Projected Mount.

2.3 TACTCILE SIGNAGE SYSTEMS

A. Acceptable Manufacturers:
1. Basis of Design: ASI Sign Systems, 3890 W. Northwest Highway, Suite 102, Dallas, TX 75220; (214) 352 9140 telephone; (214) 352 9741 facsimile; (800) ASI-SPEC (274-7446).
2. Substitutions: Submit in accordance with Section 016000.

B. Acceptable Product:
1. Basis of Design: ASI Unframed Signs with requirements indicated for materials, thickness, finish colors, designs, shapes, sizes and details.

C. Sign Face: As directed by manufacturer. Exterior-rated.

D. Tactile Graphics and Text:
1. Fabrication: Provide tactile copy and grade 2 Braille raised 1/32 inch minimum from plaque first surface by manufacturer's stratification process.
2. Provide lettering and graphics precisely formed, uniformly opaque to comply with relevant ADA regulations and requirements indicated for size, style, spacing, content, position, and colors.

E. Overall panel size: Refer to Drawings.

F. Panel colors: As selected by Architect.

G. Text or graphic colors: As selected by Architect.

H. Letter styles, colors, letter sizes and layout position: As selected by Architect.

I. Installation Method: Per manufacturer recommendations.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE

A. Deliver and store identifying devices in protective wrappings until ready for installation. Install letters in protective wrappings and remove wrappings just prior to substantial completion.

3.2 INSTALLATION

A. Install signs plumb, level and square and in proper planes with other work, at heights required by accessibility codes and standards.

B. Anchor each plastic laminate sign with adhesive.

C. Install signs with sufficient amount of foam tape for proper installation.

D. Attach as recommended by sign manufacturer.

E. Anchor each sign with adhesive.

F. Coordinate arrival and installation of graphic signs with hardware installation. Graphic signs function as and are coordinated with the hardware as shown on the Drawings.

G. Room name signs shall be placed on the public side of the door except where noted otherwise.

H. Single Door Sign: Provide one sign as specified above, mounted to wall adjacent to door on knob side.

I. Pair of Doors: Provide one sign as specified above, mounted to adjacent wall closest to active leaf of door. Do not install sign where it will be obstructed by door when door is in the 'open' position.

J. Attachment: Mounting to surfaces shall be done by pressure sensitive frame double-faced tape. Signs shall be delivered to the project site with the tape in place and trimmed on each sign, but with the protective paper layer not removed. Paper layer shall be removed just prior to installation of signs.

3.3 COORDINATION

A. Coordinate the installation of the identifying devices with the hardware manufacturer for lockset and knob leave outs as detailed and scheduled.

3.4 DAMAGE

A. Any identifying device which is scratched or defaced will be rejected.

3.5 CLEANING

A. Remove protective materials and clean all signs. Clean surfaces with plain water or water with soap or household detergent.

END OF SECTION.

SECTION 102213

WIRE MESH PARTIION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fabricated, internally tensioned metal mesh partition with frame and adjustable mounting plates for application on concrete unit masonry base for privacy between restroom stalls.

1.2 SUBMITTALS

A. Submittals for Review:
1. Samples: 12 inch long siding samples in each profile and species.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 2-years experience in work of this Section.

1.4 PROJECT CONDITIONS

A. Do not install siding on wet or frozen substrate.

B. Do not install siding at temperatures below 40 degrees F.

PART 2 PRODUCTS

2.1 MATERIALS

1. Basis of Design: Cambridge Architectural Mesh, Doral Framed Partition. Rigid Mesh.
2. Substitutions: Prior approval equal.

2.2 PERFORMANCE REQUIREMENTS

A. Corrosion-resistant, exterior tolerant metal mesh, frame, and all recommended accessories per manufacturer, appropriate for unconditioned environment and contact with humidity.

B. Mesh open area to be no less than 15% and no greater than 80%.

2.3 ACCESSORIES

A. Fasteners: Type recommended by siding manufacturer for application to concrete unit masonry.

B. Sheet Metal Flashings and Trim: Specified in Section 07 6200.

2.4 FINISH

A. As recommended by manufacturer and as approved by Architect.

PART 3 EXECUTION

3.1 PREPARATION

A. For proper installation conditions, refer to manufacturer recommendations.

3.2 INSTALLATION

A. Install in direction and sizing indicated by drawings, plumb and level, appropriately spaced.

B. Install accessories including corners, sills, and headers per manufacturer recommendations. openings. Fasten at increments recommended by manufacturer.

END OF SECTION.

SECTION 102813

TOILET ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Public-use washroom accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.7 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.8 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

C. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

E. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

F. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

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. Bobrick Washroom Equipment, Inc.
2. American Specialties, Inc.
3. Bradley Corporation.
4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

B. Accessories: As scheduled on Drawings.

2.3 PRIVATE-USE BATHROOM ACCESSORIES

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. Bobrick Washroom Equipment, Inc.
2. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

B. Accessories: As scheduled on Drawings.

2.4 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion- resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 SCHEDULE

Description	Manufacturer	Model No.
Toilet Tissue Dispenser	Bobrick	B-3588 TrimLine Series, Surface-Mounted Multi-Roll
Sanitary Napkin Disposal	Bobrick	B-35139 TrimLine Series, Surface-Mounted
36” Grab Bar	Bobrick	B-5806 x 36
42” Grab Bar	Bobrick	B-5806 x 42
Paper Towel Dispenser	Bobrick	B-359039 TrimLine Series, Surface-Mounted
Paper Towel Waste Receptable	Bobrick	B-279 Surface-Mounted
Changing Station	Bobrick	KB110-SSWM, Horizontal, Wall-Mounted
Soap Dispenser	Bobrick	B-26627 TrimLine Series, Surface-Mounted, Foam
Mirror	Bobrick	B-290 1836 Series, Welded-Frame, 18”W x 36”H
Mop & Broom Holder		
Utility Shelf		

END OF SECTION.

SECTION 116800 - PLAY FIELD EQUIPMENT AND STRUCTURES

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 playground equipment as follows:

1. Volleyball Net
2. Sky Cabin and Walk
3. Mountaineer Rope
4. Climbing Grips
5. Spinner Bowl
6. Bobcat
7. Water Lilies
8. Seesaw 4 Person
9. 4 Person Swing
10. Hillside Embankment Slide
11. 10’ Hillside Embankment Slide
12. Cadence Instrument
13. Contrabass Chimes
14. Rope Nest
15. You and Me Swing

1.3 DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

A. Definitions in ASTM F1487 apply to Work of this Section.

B. IPEMA: International Play Equipment Manufacturers Association.

C. CPSI: Certified Playground Safety Inspector

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: For each type of playground equipment.

1. Include plans, elevations, sections, and attachment details.
2. Include fall heights and use zones for playground equipment, coordinated with the critical-height values of protective surfacing specified in Section 321816.13 "Playground Protective Surfacing."

C. Samples for Initial Selection: For each type of exposed finish.

1. Manufacturer's color charts.
2. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of exposed finish on the following products:

1. Include Samples of accessories to verify color and finish selection.
2. Posts and Rails: Minimum 6 inches long.
3. Platforms: Minimum 6 inches square.
4. Molded Plastic: Minimum 3 inches square.

1.6 INFORMATIONAL SUBMITTALS

Coordinate "Qualification Data" Paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.

A. Qualification Data: For Installer, Manufacturer and Testing Agency.

B. Product Certificates: For each type of playground equipment.

C. Material Certificates: For the following items:

1. Shop finishes.

2. Wood-Preservative Treatment: Include certification by treating plant that states type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

D. Field quality-control reports.

E. Sample Warranty: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For playground equipment and finishes to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Installer must include in their proposal a certificate by the manufacturer of the equipment being installed stating they are a certified installer of said manufacturer's equipment. Qualifying installer must have a minimum of 5 years of experience installing proposed manufacturer's equipment. Installer to provide 3 project references of certified installations accompanied with photos of installations, owners name and contact information.

1.9 WARRANTY

When warranties are required, verify with Owner's counsel that warranties stated in this article are not less than remedies available to Owner under prevailing local laws.

A. Special Warranty: Manufacturer agrees to repair or replace components of playground equipment that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain playground equipment from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Safety Standard: Provide playground equipment according to ASTM F1487.

2.3 FREESTANDING PLAY FIELD EQUIPMENT

A. Volleyball Net: Basis of Design Product – Blast Complete Volleyball Set including boundary antennas, color – black, embedded mounting, as manufactured by First Team Sports, Inc., Hutchinson, KS, 800-649-3688 or approved equal.

1. Quantity and location as indicated on Drawings.

2.4 FREESTANDING PLAYGROUND EQUIPMENT NOT IN CONTRACT FOR REFERENCE ONLY

A. Volleyball Net: Basis of Design Product – Blast Complete Volleyball Set including boundary antennas, color – black, embedded mounting, as manufactured by First Team Sports, Inc., Hutchinson, KS, 800-649-3688 or approved equal.

1. Quantity and location as indicated on Drawings.

B. Sky Cabin and Walk: Basis of Design Product – embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

C. Mountaineer Rope: Basis of Design Product – embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

D. Climbing Grips: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

E. Spinner Bowl: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

F. Bobcat: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

G. Water Lilies: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

H. Seesaw 4 Person: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

I. 4 Person Swing: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

J. Hillside Embankment Slide: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

K. 10’ Hillside Embankment Slide: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

L. Cadence Instrument: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

M. Contrabass Chimes: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

N. Rope Nest Swing: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

O. You and Me Swing: Basis of Design Product - embedded mounted, as manufactured by Kompan Austin, Texas, 800 426 9788, or approved equal.

1. Quantity and location as indicated on Drawings.

2.5 FABRICATION

A. Provide sizes, strengths, thicknesses, wall thickness, and weights of components as required to comply with requirements in ASTM F 1487. Factory drill components for field assembly. Unnecessary holes in components, not required for field assembly, are not permitted. Provide complete play structures, including supporting members and connections, means of access and egress, designated play surfaces, barriers, guardrails, handrails, handholds, and other components indicated or required for equipment indicated.

1. Manufacturer’s standard baked-enamel or powder-coat finish on metal work. Color as indicated herein or as selected by Landscape Architect from Manufacturer’s full range.

2.6 ADDITIONAL MATERIALS

A. Hardware: Manufacturer's standard; commercial-quality; corrosion-resistant; hot-dip galvanized steel and iron, stainless steel, or aluminum; of a vandal-resistant design.

B. Fasteners: Manufacturer's standard; corrosion-resistant; hot-dip galvanized or zinc-plated steel

1. and iron, or stainless steel; permanently capped; and theft resistant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for earthwork, subgrade elevations, surface and subgrade drainage, and other conditions affecting performance of the Work.

2. Do not begin installation before final grading required for placing playground equipment and protective surfacing is completed.

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

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions for each equipment type unless more stringent requirements are indicated. Anchor playground equipment securely, positioned at locations and elevations indicated.
1. Maximum Equipment Height: Coordinate installed fall heights of equipment with finished elevations and critical-height values of protective surfacing. Set equipment so fall heights and elevation requirements for age group use and accessibility are within required limits. Verify that playground equipment elevations comply with requirements for each type and component of equipment.

B. Post and Footing Excavation: Excavate holes for posts and footings as indicated in firm, undisturbed or compacted subgrade soil.

C. Post Set with Concrete Footing: Comply with Section 033000 "Cast-in-Place Concrete" for measuring, batching, mixing, transporting, forming, and placing concrete.

1. Set equipment posts in concrete footing. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at the correct angle, alignment, height, and spacing.
   a. Place concrete around posts and vibrate or tamp for consolidation. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
2. Embedded Items: Follow equipment manufacturer's written instructions and drawings to ensure correct installation of anchorages for equipment.
3. Finishing Footings: Smooth top, and shape to shed water.

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Perform inspection and testing for each type of installed playground equipment according to ASTM F1487.

B. Playground equipment items will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

D. Notify Landscape Architect and Owner 48 hours in advance of date(s) and time(s) of testing and inspection.

END OF SECTION 116800

SECTION 129300 – SITE FURNISHINGS

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. Bike Rack.
2. Park Centre Table.
3. Mixx Square Table.
4. Park Centre Chair.
5. Mixx Stool.
6. Trash Receptacle.
7. Recycling Receptacle.
8. Adirondack Chair.
9. Mutt Mitt Station.
10. BBQ Grill.
11. Hot Coal Bin.
12. Dog Waste Bag Supply.
13. Dog Drinking Fountain.
14. Playground Drinking Fountain.
15. Ping Pong Table.
16. Hammock.
17. Cocktail Table.
18. Hand Sanitizer Dispenser.
19. Log Bench.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.

C. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 BIKE RACK

A. Basis of Design Product: Tandem Stainless Steel Bick Rack In-Ground Mount, embedded, color/finish – stainless steel, as manufactured by Anova Site Furnishings, St. Louis. MO, 800-231-1327 or approved equal.

1. Quantity and location as indicated on Drawings.

2.2 PARK CENTRE TABLE

A. Basis of Design Product: Park Centre Table, Model 30” Round, color – flambe orange, as manufactured by as manufactured by Landscape Forms, Kalamazoo, MI, 800-430-6209 or approved equal.

1. Owner provided, Contractor to assemble and install.

2. Quantity and location as indicated on Drawings.

2.3 MIXX SQUARE TABLE

A. Basis of Design Product: Mixx 42” Square Thermory® Table, Model – MIX2920T, color – textured teal, as manufactured by Anova Site Furnishings, St. Louis. MO, 800-231-1327 or approved equal.

1. Owner provided, Contractor to assemble and install.

2. Quantity and location as indicated on Drawings.

2.4 PARK CENTRE CHAIR

A. Basis of Design Product: Park Centre Chair, Model – Chair No Arms, color – flambe orange, as manufactured by as manufactured by Landscape Forms, Kalamazoo, MI, 800-430-6209 or approved equal.

1. Owner provided, Contractor to assemble and install.

2. Quantity and location as indicated on Drawings.

2.5 MIXX STOOL

A. Basis of Design Product: Mixx Thermory® Stool, Model – MIX2927T, color – textured teal, as manufactured by Anova Site Furnishings, St. Louis. MO, 800-231-1327 or approved equal.

1. Owner provided, Contractor to assemble and install.

2. Quantity and location as indicated on Drawings.

2.6 TRASH RECEPTACLE

A. Basis of Design Product: Metrix Trash Receptacle with Dual Side Openings and Side Door, Model – L2019 with DEC2002, color – textured silver, as manufactured by Anova Site Furnishings, St. Louis. MO, 800-231-1327 or approved equal.

1. Owner provided, Contractor to assemble and install.

2. Quantity and location as indicated on Drawings.

2.7 RECYCLING RECEPTACLE

A. Basis of Design Product: Metrix Trash Receptacle with Dual Side Openings and Side Door, Model – L2020 with DEC5002, color – textured silver, as manufactured by Anova Site Furnishings, St. Louis. MO, 800-231-1327 or approved equal.

1. Owner provided, Contractor to assemble and install.

2. Quantity and location as indicated on Drawings.

2.8 ADIRONDACK CHAIR

A. Basis of Design Product: Plank Chair with Armrests, Thermory®, Model – PLK60T, color – teal frame, as manufactured by Anova Site Furnishings, St. Louis. MO, 800-231-1327 or approved equal.

1. Owner provided, Contractor to assemble and install.

2. Quantity and location as indicated on Drawings.

2.9 DOG WASTE STATION

A. Basis of Design Product: Dog Waste Station (with Mutt Mitt® 2-Ply), Model – 1006, Complete Pet Waste Station, 2-Ply, White, color – white, embedded mounting, including sign, square post painted black, waste can, dispenser, 400 Mutt Mitt® 2-Ply Bags and 50 can liners, as manufactured by Mutt Mitt, San Diego, CA, 800-697-6084 or approved equal.

1. Quantity and location as indicated on Drawings.

2.10 BBQ GRILL

A. Basis of Design Product: Accessible Grill, Model – ASW-20 embedded mount, as manufactured by Pilot Rock, Cherokee, IA, 800-762-5002 or approved equal.

1. Quantity and location as indicated on Drawings.

2.11 HOT COAL BIN

A. Basis of Design Product: Hot Coal Bin, Model – HCB/B1, color – high heat black enamel, including CNG-2310C 31 Gallon Galvanized Steel Collection Can and M9/B Hot Coal Bin Ground Anchors as manufactured by Pilot Rock, Cherokee, IA, 800-762-5002 or approved equal.

1. Owner provided, Contractor to assemble and install.

2. Quantity and location as indicated on Drawings.

2.12 DOG DRINKING FOUNTAIN

A. Basis of Design Product: Model 440 SM-FA with optional stainless steel surface carrier, cutoff valve with low point drain and unattached valve box, surface mount, color – textured pyrite, as manufactured by Most Dependable Fountains, Inc., Arlington, TN, 901-867-0039 or approved equal.

1. Size, quantity, location, and layout as indicated on Drawings.

2.13 PLAYGROUND DRINKING FOUNTAIN

A. Basis of Design Product: Model 440 SM with optional stainless steel surface carrier and pet fountain, cutoff valve with low point drain and unattached valve box, surface mount, color – textured pyrite, as manufactured by Most Dependable Fountains, Inc., Arlington, TN, 901-867-0039 or approved equal.

1. Size, quantity, location, and layout as indicated on Drawings.

2.14 PING PONG TABLE

A. Basis of Design Product: Popp Ping Pong Table, Model Icon, color – tabletop Emerald Green RAL 6001, Frame Super Durable Wet White, Net Super Durable Wet White, as manufactured by Public Outdoor Ping Pong, +61 407084817 or approved equal.

1. Owner provided, Contractor to assemble and install.

2. Size, quantity, location, and layout as indicated on Drawings.

2.15 HAMMOCK

A. Basis of Design Product: Model Blanco Jumbo Polyester Tree Hammock, color – yellow, as manufactured by Wayfair, Boston, MA, 844-609-9914 or approved equal.

1. Owner provided, Contractor to assemble and install.

2. Size, quantity, location, and layout as indicated on Drawings.

2.16 COCKTAIL TABLE

A. Field-located, solid (non-rotten), fallen tree trunk. Debark, saw ends and finish with wood sealer.
1. Trunk Type: As indicated on Drawings.
2. Size: As indicated on Drawings.
3. Sealer: Manufacturer's standard transparent (clear, matte finish), penetrating, long (waterproofing) oil-based, wood sealer. Apply (two coats minimum) after text engraving into trunk and in accordance with Manufacturer's written instructions.

2.17 HAND SANITIZER DISPENSER

A. Basis of Design Product: Hand Sanitizer Model 393, color – black, as manufactured by Most Dependable Fountains, Inc., Arlington, TN, 901-867-0039 or approved equal.

1. Size, quantity, location, and layout as indicated on Drawings.

2.18 LOG BENCH

A. Field-located, solid (non-rotten), fallen tree trunk. Debark, saw ends and finish with wood sealer. Custom engrave text to uniform depth into trunk as indicated on Drawings.
1. Trunk Type: As indicated on Drawings.
2. Size: As indicated on Drawings.
3. Text and Typeface: Typeface matching Landscape Architect's sample indicated on Drawings.
4. Sealer: Manufacturer's standard transparent (clear, matte finish), penetrating, long (waterproofing) oil-based, wood sealer. Apply (two coats minimum) after text engraving into trunk and in accordance with Manufacturer's written instructions.

2.19 ACCESSORIES

A. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or non-corrodible materials; commercial quality, tamperproof, vandal and theft resistant, and concealed, recessed, and capped or plugged.

1. Angle Anchors: For inconspicuously bolting legs of site furnishings to on or below-grade substrate; one per leg.
2. Antitheft Hold-Down Brackets: For securing site furnishings to substrate; two per unit.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

END OF SECTION 129300

SECTION 131213 - INTERACTIVE WATER FEATURE

PART 1 - GENERAL REQUIREMENTS:

1.01 RELATED SECTIONS AND DOCUMENTS:

The General provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to the work specified in this section.

Other related sections include the following:

Division 3 – Concrete (for additional concrete and finishing requirements.)
Division 22 – Plumbing
Division 23 – Heating Ventilating and Air Conditioning
Division 26 – Electrical
Division 31 –Earthwork (for additional sub-grade preparation for interactive water feature and interactive water feature system backfilling requirements.)

Division 00 – Procurement and Contracting Requirements and Division 1 – General Requirements, as indexed, apply to this section. Comply with the provisions of the codes, specifications and standards of the Department of Health for the public interactive water features and other applicable codes and regulations and as shown on the drawings and/or hereinafter specified. The interactive water feature contractor is responsible to submit plans to the local Health Department for approval. Plans shall be reviewed, approved and stamped by the Health Officer and Building Department before the contractor may begin construction. See Division 1 – General Requirements for additional information.

1.02 SCOPE:

“Interactive Water Feature” or “Splash Pad” or “River” or “Pool” or “Feature” means any Interactive Feature / River etc. shown as part of this project. Herein the feature shall be designated as Interactive Water Feature. The Interactive Water Feature Contractor shall furnish and install the Interactive Water Feature including but not limited to the reinforced concrete feature / river, structures, finishes, piping, fittings, circulation and filtration equipment, sanitizing systems, deck tiles, grating, waterproofing, sealants & caulking, water play features, etc. shown on the Interactive Water Feature drawings and as specified herein (unless otherwise determined by the General Contractor as part of scope delineation).

1.03 INTERACTIVE WATER FEATURE CONTRACTOR'S RESPONSIBILITY:

The Interactive Water Feature Contractor shall provide the following services:

Provide and pay all costs relative to start up and or training of owner's designated operator in the correct use of equipment required for the Interactive Water Feature function and operation as recommended by the product manufacturers. Interactive Water Feature Contractor shall supply a qualified field technician for this purpose.

Provide chemicals for interactive water feature operation at time of start-up. Provide liquid chlorine, hydrochloric acid, and cyanuric acid as aids in maintaining chemical balance. The interactive water feature contractor is responsible to maintain proper balancing tank water chemistry and keep the interactive water feature, pump vault and balancing tank swept and vacuumed clean until the project substantial completion and the interactive water feature is turned over to the owner.

1.04 MEASUREMENTS:

During bidding, the contractor shall examine the site and compare it with the drawings and specifications. Verify all dimensions shown on Drawings by taking field measurements; proper fit and attachment of all parts is required. Before commencing work, check all lines and levels indicated and such other work as has been completed. Should there be any discrepancies, immediately report in writing to the Architect.

1.05 COORDINATION:

Coordinate work with other trades (Electrical, Mechanical, Plumbing, General, etc.). Coordinate with the soils engineer, soils testing contractor and General Contractor to assure proper grading, soil properties, compaction requirements, membranes, and sub drain locations and installation before commencing work.

1.06 DELIVERY AND STORAGE:

Deliver materials undamaged to the job site in each manufacturer’s unopened containers. Inspect for damage and remove damaged items from job site. Store and adequately protect undamaged materials against damage while temporarily stored at the site. Store materials off the ground under protective covers.

1.07 SUBMITTALS:

Submit five (5) copies of manufacturer's performance data, specifications and installation instructions for each accessory and/or equipment specified. Submittal shall be, as a minimum, bound in a three ring binder with labels and tabs for each submittal category. As an alternate means of submittal, the submittals may be provided as one joined pdf format with the information as described above – with each cut-sheet identified for its intended use (individual pdfs are not acceptable and will be required to be resubmitted). Also see requirements of Division 1. Submittal shall be made to the Architect for approval prior to beginning any work on the pool.
Submit for the following:

1. Pipe & Pipe Fittings
2. Valves, each type
3. Balancing Tank Fittings
4. Interactive water feature Frame & Grates
5. Interactive water feature Features / Fittings
6. Feature Controller
7. Variable Frequency Drive
8. High Rate Sand Filter
9. Pumps with and without integral hair and lint strainers
10. Hair and Lint Strainers

11. Basket Strainer
12. Chemical Controller w/ sensors (complete with water level control)
13. Chemical Feeders
14. Chemical Storage Vessels
15. Chemicals (MSDS Sheets)
16. Ultra Violet (UV) Disinfection System
17. Flow Meter Sensor
18. Gauges, Meters and Instrumentation
19. Pre-Fabricated Concrete Balancing Tank (with access hatch and grated vent)
20. Pre-Fabricated Concrete Pump Vault (with access hatch)
21. Pipe Penetration Seals and Sleeves
22. Waterproofing Materials
23. Sealants and Caulking
24. Expansion Joint Materials
25. Waterstops
26. No Running Tiles
27. Interactive Water Feature Area Safety Signs
28. Chemical Room Safety Signs
29. Cleaning Equipment including Portable Vacuum
30. Water Test Sets
31. Concrete Experience Data
32. Quality Assurance Information
33. Non-structural Components
    a. Provide the details and engineering calculations (wet stamped and signed) for all non-structural components permanently attached to structures and their supports and attachments, designed to resist the effects of earthquake motions in accordance with ASCE 7-05.
    b. Submit to building department as a deferred submittal (if required by building inspector).

Product Sample Submittals:

1. Interactive water feature Finish: Concrete Mock-Up
   Submit one 24” x 24” mock-up with a finish as called for in the project document. Submittal of sample shall be made to the Landscape Architect for approval prior to beginning any work on the interactive water feature.

Shop Drawings Required:

1. Animation Control Panel
   - Submit panel design and components.
   - Submit sequence choreography, including simulation.
   - See section 7 for additional requirements.

1.08 SUBSTITUTIONS:

If any contractor wishes to submit a substitution / equivalent / or an alternate recirculation system, filter, and/or water feature item, the contractor shall submit plans and specifications to the Architect for approval at least ten (10) days prior to the bid date. Said plans and specifications shall be for this specific project, and show the installation of the proposed equipment. All changes required in the interactive water feature structure and in the building construction shall be listed in order to

determine the extra costs or savings thereof. Substitutions, equivalents, and alternates submitted for the interactive water feature system shall also include all of the submittal information required in Section 13 1213, Paragraph 1.07 (with the exception of the full shop drawings) to the Architect for approval at least ten (10) days prior to the bid date.

Whenever the words "or equal," "or approved equal" appear in the specification or plans, they shall be interpreted to mean material or an item of equipment equal in quality to that named. The burden of proof of quality or service shall be on the supplying contactor. Proof of inequality is not implied by the specifications and is not a burden of the owner or his representatives. The Architect shall be sole judge as to whether or not an item submitted as an equal is acceptable. If the Interactive water feature Contractor submits a substitution on an "equal" basis, he shall assume all risks involved should the architect find it not acceptable. The Interactive water feature Contractor shall assume all costs for charges in drawings and specifications affected by the substitution, and the cost increase, if any, on adjoining work.

1.09 PATENTED MATERIALS:

The Interactive Water Feature Supplier/Contractor shall pay all royalties and license fees. The Interactive Water Feature Contractor shall defend all suits or claims for infringement of any patent rights and shall save the Owner, the General Contractor, the Interactive water feature Engineer, and the Architect harmless from the loss on account thereof, except that the Interactive water feature Contractor shall not be responsible for all such loss when a particular manufacturer or manufacturers is specified. But, if the Interactive water feature Contractor has reason to believe that the design, process, or product specified is an infringement of a patent, he shall be responsible for such loss unless he promptly gives such information to the General Contractor, Interactive water feature Engineer, Owner, and Architect. Also see General Conditions and Division 1.

1.10 GUARANTEE:

Provide Guarantee / Warranty per GENERAL CONDITIONS, and per each individual piece of equipment and/or accessory as listed by manufacturer.

1.11 INSPECTION:

Examine all sub surfaces to receive work and report in writing to the Architect any conditions detrimental to work. Failure to observe this injunction constitutes a waiver to any subsequent claims to the contrary and will make this Contractor responsible for any corrections the Architect may require. Continuation of work will be construed as acceptance of all sub surfaces.

1.12 QUALIFICATION OF INTERACTIVE WATER FEATURE CONTRACTOR:

The apparent low bidder shall deliver to the Architect, Owner, & Interactive water feature Engineer for approval the following experience data in writing within 24 hours after the bid opening, for verification of experience of the Interactive water feature Contractor:

1. That the interactive water feature contractor shall be a state-licensed commercial swimming pool contractor.

2. That the prospective bidder has demonstrated suitable technical experience by having successfully installed at least two (2) interactive water features of the material, design, complexity, and extent to that indicated for this project within the past five years. List the principals to contact regarding said interactive water features so that proper inquiries can be made as to their completion, interactive water feature technology used, operation, etc., relative to such construction.

3. Only interactive water features constructed by the firm submitting the bid will be considered. Interactive water features by another company or individual in the employ of another concern shall not be considered.

4. A list of the major public pool and interactive water feature jobs he currently has under contract, the amount of the contracts and the current percentage of completion.

The interactive water feature contractor shall provide a qualified project manager throughout the contract period with experience managing projects with the construction type, size and scope similar to this project. The project manager shall be on site as required to assure proper coordination, scheduling, and performance of work.

The interactive water feature contractor shall be bondable and shall furnish a letter of intent to furnish 100% Performance and Payment Bond from their bonding agency. The interactive water feature contractor shall furnish proof of all liability insurance, etc. and also that of any subcontractor. Also see General Conditions and Division 1.

1.13 CODES AND STANDARDS:

Comply with the provision of the codes, specifications, and standards of the ANSI/NSPI standard, the current International Building Code standards, International Fire Code Standards, Local Building Department standards, and County Department of Health standards for public swimming pools, and other applicable codes and regulations and as shown on the drawings and/or hereinafter specified.

- Texas Pool-Related Health Codes, including title 25, chapter 265
- Texas PIWFF Codes, including title 25, chapter 265.301-308
- TCEQ codes as applicable
- NEC section 680

In addition to those standards referenced above, work in this section shall conform to requirements of the following reference standards, as applicable, unless otherwise required herein or on the drawings. Unless otherwise indicated on the drawings, or specified, furnish the highest or best grade of material specified in referenced standards.

1. American National Standards Institute (ANSI):
   a. A13.1-81 Scheme for the identification of Piping Systems
2. American Society for Testing and Materials (ASTM):
   a. A36-81A Structural Steel
   b. A120-83 Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless, for Ordinary Uses

c. A123-78 Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes
d. A153-82 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
e. A386-78 Zinc Coating (Hot-Dip) on Assembled Steel Products
f. D1785-81 Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
g. D1785-83 Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120
h. D2464-76 Threaded Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
i. D2467-76A Socket-Type Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80
j. D2564-80 Solvent Cements for Polyvinyl Chloride (PVC) Plastic Pipe and Fittings
k. D2774-04 Underground Installation of Thermoplastic Pressure Piping
l. F1668-96 Construction Procedures for Buried Plastic Pipe
m. F2376-08 Classification, Design, Manufacture, Construction, and Operation of Water Slide Systems.
n. F2461-09 Manufacture, Construction, Operation, and Maintenance of Aquatic Play Equipment.
o. C94 Standard Specification for Ready-Mix Concrete

3. Manufacturers Standardization Society of Valves and Fittings Industry (MSS):
   a. SP-58-1983 Pipe Hangers and Supports - Materials and Design
   b. SP-69-1983 Pipe Hangers and Supports - Selection and Application
4. National Fire Protection Association (NFPA):
   a. National Electric Code (NEC) (applicable adopted year of publication)
   b. National Fire Protection Association (NFPA) - Standard No. 704
5. Other Codes and Standards:
   a. Texas Administrative Code Title 25 Chapter 265 Subchapter M; Public Interactive Water Features and Fountains (PIWF).
   b. Not Used
   c. NSF - Standard 50 & Standard 61
   d. U.S. EPA - Clean Water Act
   e. UFC - Article 80
   f. American Public Health Association Public Swimming Pools: Recommended Regulations for Design and Construction, Operation and Maintenance"
   g. WWA - Construction for Operating Safely
   h. IAPMO Standard IAPMO / ANSI Z 124.7-1997 for a fiberglass reinforced plastic spa pool
   i. OSHA 29 CRF - Hazard Communication Standard
   j. National Spa and Pool Institute (NSPI) Standards: ANSI/NSPI-1 2003: American National Standard for Public Swimming Pools.
   k. US EPA - SARA Title III
   l. UFC - Standard No. 79-3
   m. National Sanitation Foundation - Standard Number 50: Circulation System Components for Swimming Pools, Spas, or Hot Tubs: NSF Listings: Swimming Pools, Spas, and Hot tubs
   n. FIFRA - Worker Safety Regulations
   o. National Electrical Code (NEC) (applicable adopted year of publication) Article 680: Swimming Pools, Fountains, and Similar Installations
   p. US EPA - 40 CFR 122.26
   q. OSHA - CFR 1910.146

r. APHA - Model Swimming Pool Code
w. CDC - Proper Swimming Pool Design
t. CDC - Water Slide Flumes
u. CDC - Public Spas and Hot tubs
v. UL - Green Book
w. UL - Yellow Book
x. The Chlorine Institute - Safety at Nonresidential Pools
y International Building Code (IBC) applicable adopted year of publication
z. International Fire Code (IFC) applicable adopted year of publication
1. Chapters on Hazardous Materials, Corrosive Materials, Oxidizers and any other applicable chapters
aa. ANSI - Standard 14.3 for Ladders and Safety Equipment
bb. ASME - Standard A13.1 for pipe labeling and marking code

1.14 RELATED WORK AND RESPONSIBILITIES OF THE GENERAL CONTRACTOR:

General responsibilities of the General Contractor shall be as follows:

Harmful Chemicals: No contractor or his workmen shall place any acid or alkaline chemicals or oil in contact with interactive water feature which will be injurious to the interactive water feature or interactive water feature materials.

Contact with Other Systems: General Contractor shall not hang or connect pipe, electrical conduit, or any other materials to the interactive water feature system.

The General Contractor shall furnish labor, material, services, equipment, and appliances necessary to perform the following work in connection with installation of the interactive water feature, as required by the approved drawings and specified herein:

Locations: General Contractor shall be responsible for horizontal dimensions and grade elevations accurately from established lines and bench marks, as required by the drawings, and be responsible for those grades.

Safeguards: Provide, erect and maintain all necessary barricades, signs, lights and flares to protect workmen and the public.

The general contractor is responsible for implementing and enforcing a confined-space entry safety plan per OSHA prior to performing any work in the balancing tank or the pump vault.

Provide temporary light, heat, water, and power service to installation area, as may be needed for construction. Provide water to fill the interactive water feature balancing tank.

Precaution: Do not bring in or operate compaction equipment, trucks or other heavy equipment within five feet of the interactive water feature, its components, the balancing tank or pump vault.

Responsibility for Damage: The General Contractor shall protect the interactive water feature from damage during surrounding construction, back-filling and deck installation and shall be responsible

for the cost of repairs for damage to the interactive water feature caused by his construction equipment and/or workmen.

Sub-Drain: General Contractor shall provide and install permanent sub-drain system underneath the interactive water feature, balancing tank and / or pump vault in areas where there is a potential for groundwater.

Site Preparation: The General Contractor shall provide all site preparation per the recommendations of an owner provided site specific project soils report to ready the site for the interactive water feature excavation and interactive water feature installation requirements. Also see Section 2300 –Earthwork.

Site Preparation Structural Backfill: Also see Section 2300 –Earthwork. General Contractor shall thoroughly compact any backfill that is around or supports any interactive water feature piping equipment or components to 95% Modified Proctor. It shall be compacted in 8" loose layers to 95% of maximum dry density based on ASTM D1557. All fill shall be tested. Contractor will be responsible for any damage to the work as a result of that compaction. The General Contractor shall provide all site preparation backfill per the recommendations of an owner provided site specific project soils report to ready the site for the interactive water feature excavation and interactive water feature installation requirements.

Disposal: Remove excess and unsuitable soil and materials. Dispose of said materials on or off the site as directed by the Architect or Owner. This includes excess soil as a result of the interactive water feature, pump vault and balancing tank excavation. Interactive water feature contractor is responsible to stockpile excess soil on site at General Contractor's direction.

Concrete Work: General Contractor shall construct backwash pit of reinforced concrete as per Architectural drawings, interactive water feature drawings and structural drawings. Coordinate between all drawings and notify architect immediately if a discrepancy is found.

Balancing Tank: General Contractor shall provide and install continuous Ribbed Centerbulb water stops at all joints of the tank. The waterstops shall be compatible with the concrete system, the liquids and/or chemicals to be contained or controlled, and be able to be subjected to the hydrostatic pressures created within. The General Contractor shall fill any holes created by form ties with neat cement. Concrete finish of backwash pit shall be as smooth as possible as to receive two coats of waterproofing in accordance with manufacturer's directions (waterproofing by Interactive water feature Contractor). The General Contractor shall coordinate with the interactive water feature contractor for method of finishing pit.

Chemical Storage Rooms: Chemical storage rooms and hardware shall be constructed of corrosive-resistant materials. Walls shall of non-corrosive construction, resistant to the effects of storage of a corrosive material. Separate ventilation of each chemical roof shall be provided.

Sleeves: Install the sleeves necessary for required piping in the building walls. The Interactive water feature contractor will provide all sleeves. The General Contractor shall coordinate locations with the interactive water feature contractor. If the Interactive water feature Contractor fails to coordinate this work with the General Contractor and provide the required sleeves, couplings, and O-rings and the required sleeves are not installed, the Interactive water feature Contractor is responsible for concrete removal and installation of the sleeves or for any core-drilling required (only

if allowed by structural engineer). If the General Contractor fails to install the sleeves, couplings, and O-rings as coordinated by the Interactive water feature Contractor, the General Contractor is responsible for concrete removal and installation of the sleeves or for any core-drilling required (only if allowed by structural engineer).

Equipotential Bonding Grid: The General Contractor shall provide the equipotential bonding grid in and around the interactive water feature perimeter per the requirements of the National Electric Code, Article 680.

Deck Slab: Surrounding deck slabs shall be placed after interactive water feature installation has been completed, including the deck expansion joints with polysulfide sealant, as detailed on the interactive water feature plan and details.

Protecting Interactive water feature: Contractor shall take every practical precaution to prevent concrete from spattering on the finishes, etc., including covering same with protective materials. If splash occurs, wash off while still wet, any concrete which appears on these elements. Any damaged or broken material shall be immediately repaired.

Clean-up: Keep the interactive water feature excavation and interactive water feature free of construction residue and waste materials of his workmen or sub-contractors, removing said material from the interactive water feature should it collect.

Site Storage: Protect materials and equipment stored on job site.

Coordination at Start-up: Provide representative at time of interactive water feature start-up to coordinate work related to interactive water feature system.

1.15 RELATED WORK AND RESPONSIBILITY UNDER MECHANICAL / PLUMBING DIVISION:

General responsibilities of the Mechanical/Plumbing contractor shall be, but not limited to, as follows:

Harmful Chemicals: Mechanical/Plumbing Contractor shall not place any acid, alkaline chemicals or oil in contact with the interactive water feature which will be injurious to interactive water feature or materials.

Contact with Other Systems: Mechanical/Plumbing Contractor shall not hang or connect pipe, electrical conduit, or any other materials to the interactive water feature system unless specifically approved in writing.

The Mechanical/Plumbing Contractor under Mechanical Division shall perform the following related work in accordance with plans and specifications:

Provide drains and connect waste piping from equipment room floor drains and pump vault drains to sanitary sewer lines.

Provide separate ventilation of each of the chemical storage rooms to the outside.

Supply and install emergency shower/eyewash with tepid water and drain line at the locations shown on the pool drawings.

Furnish and run the potable water supply lines to the point or points shown on the drawings.

Provide a hose bib(s) per code requirements.

Coordination at Start-up: Provide representative at the time of interactive water feature start-up to coordinate work related to the interactive water feature system.

1.16 RELATED WORK AND RESPONSIBILITY UNDER ELECTRICAL DIVISION:

General responsibilities of the Electrical Contractor under Electrical Division shall be, but not limited to, as follows:

Provide electrical service (of adequate type and capacity required for the project) to equipment. Furnish all panels, start-stop stations, motor starters, line voltage conduit, disconnects, junction boxes, and wiring.

Make all electrical connections to the interactive water feature circulation and feature equipment, including interlocking and line voltage control wiring at the direction of the interactive water feature contractor. The interactive water feature contractor is responsible for low voltage (non-line voltage) control wiring, connections and any required conduit.

Be responsible for proper calibration, adjustment, and arrangement of terminal connections of wires to control equipment.

Perform all required grounding and bonding for pumps, filters, and other interactive water feature equipment in accordance with the National Electric Code Article 680 as well as state and local codes.

Furnish and install a Ground Fault Interrupter (G.F.I.) for all required equipment together with any and all other outlets and equipment in or around the interactive water feature as per N.E.C. Article 680.

Furnish and run all power to the chemical control system, chemical feed pumps, U.V. control system and control circuits to the support equipment.

Interlock the chemical control system to the interactive water feature circulation pump as directed by the interactive water feature contractor.

Interlock the chemical control system with the chemical feed system as directed by the interactive water feature contractor.

Interlock the Ultra Violet Disinfection system controller to the circulation pump as described on the interactive water feature plans.

Interlock the interactive water feature controller and components to the interactive water feature pump as directed by the interactive water feature contractor.

Furnish any temporary power needed by the General or Interactive water feature Contractor for de-watering, tools, etc., if required.

The well point or de-watering equipment (if required) must be continuously operated during construction. Therefore electrical service for such equipment must be sufficient to provide continuous service exclusive of temporary electrical service requirements of others.

Coordination at Start-Up: Provide representatives at the time of interactive water feature start-up to coordinate work related to interactive water feature system.

1.17 RELATED WORK AND RESPONSIBILITIES OF OWNER:

General responsibilities of the Owner shall be, but not limited to, as follows:

Harmful Chemicals: No one shall place any acid or alkaline chemicals or oil in contact with interactive water feature surfaces which will be injurious to the interactive water feature or materials.

Contact with Other Systems: No one shall hang or connect pipe, electrical conduit, or any other materials to the interactive water feature system unless specifically approved in writing by Interactive water feature Contractor.

Provide the following personal safety items for Interactive water feature Operator's use in handling chemicals: goggles, rubber aprons and rubber gloves.

Acknowledge receipt of operating Instructions at time of start-up.

The Owner shall provide the following repeated services:

Provide the designated interactive water feature operator(s) to the interactive water feature contractor for instruction and training at the time of initial filling. Make them available continuously (8:00 a.m. to 5:00 p.m. Monday through Friday) until acceptance of project.

Maintain the watertight integrity of all interactive water feature deck joints around interactive water feature for the life of the interactive water feature to minimize differential settlement.

1.18 LAYOUT WORK:

Before any interactive water feature excavation or construction is commenced, the Interactive water feature Contractor shall layout the perimeter of the interactive water feature.

1.19 EXCAVATION AND GRADING:

All labor and necessary equipment for rough machine excavation of interactive water feature areas, the interactive water feature balancing tank shall be provided. Also furnish all necessary labor and equipment required for hand trimming of interactive water feature excavation. The Contractor shall

be fully responsible for directing all excavation operations in order to obtain proper depths and contours for the interactive water feature.

The contractor is responsible for removal of excess soil to a location on site. Removal of excess soil and materials from the site is the responsibility of the General Contractor and shall be done as directed by the Architect/Owner.

Any voids which may occur due to over-excavation or from removal of boulders shall be filled with a lean mixture of concrete or earth compacted to 95% Proctor or per soils report.

A tolerance of plus one inch shall be allowed in the excavation sub grade.

1.20 PLACE FITTINGS:

The Interactive water feature Contractor shall place, before the concrete work is commenced, all piping, fittings, nozzles, all special interactive water feature equipment, etc., that are to be embedded in concrete and shall be responsible for their positioning in accordance with the drawings.

1.21 GROUNDING AND BONDING:

After placing interactive water feature reinforcing, but before placing concrete surfaces, the General Contractor shall install all the bonding and grounding circuits required for steel reinforcement and all other metal and electrical items in or around the interactive water feature. The contractor shall extend the bonding and grounding systems to the equipment room in accordance with the requirements of the National Electrical Code, Article 680. No concrete shall be applied to interactive water feature surfaces until this requirement is complied with and the proper electrical inspection has been made and approval received.

1.22 BACKFILL:

Any necessary backfill around water balancing tank walls shall be a granular backfill. Granular backfill shall be a 'pea" gravel or ¾” to 1½” minus gap-graded gravel, or as specified by the Soils Engineer. Any back filling around water balancing tank and pump vault walls is the responsibility of the General Contractor (per Section 1.12 RELATED WORK AND RESPONSIBILITIES OF THE GENERAL CONTRACTOR).

1.23 DEWATERING:

If the interactive water feature, pump vault and/or balancing tank is constructed in a hydro-static area, the Interactive water feature Contractor shall install the necessary gravel pack well point or points and permanent piping for his use during construction. A readily accessible connection to this system for the future use of the Owner shall be provided. The method of this de-watering system shall be approved by the Architect and Interactive water feature Engineer prior to excavation. Also see Civil Drawings and/or Mechanical Drawings for sub-drain designs.

PART 2 - MATERIALS AND METHODS OF INSTALLATION:

2.01 STEEL REINFORCEMENT:

All reinforcing steel shall be standard sizes of deformed bars equal to the requirements of the "Standard Specifications for Billet Steel, Concrete Reinforcement", intermediate grade, serial designation A615 with required grade designation per plans as adopted by the American Society for Testing Materials.

All reinforcing steel shall be in place before concrete placing is commenced, shall be new, free from dirt, oil, paint, and mill scale, shall be positioned and of the size indicated on the drawings, and secured by not less than 16 gauge annealed tie wire. Metal chairs or concrete blocks shall be used to insure proper spacing.

Slab steel shall be securely wired together at as many points as necessary where bars cross to insure their maintaining their position. Splices shall be staggered a minimum of 4'-0", and laps shall be not less than 40 diameters.

2.02 SPECIAL INSTRUCTIONS:

After placing interactive water feature reinforcing and water feature footing reinforcing, but before pouring concrete surfaces, the Interactive water feature Contractor shall insure proper bonding and grounding circuits have been provided and tested for continuity by the Electrical Contractor to steel reinforcement, slab, fittings, nozzles, free standing features, and all other metal and electrical items in or around the interactive water feature, as required by the National Electrical Code, Article 680. No concrete shall be applied to interactive water feature surfaces or feature footings until requirement is complied with. Also see Electrical Division.

2.03 CEMENT:

All cement for concrete work shall conform to the requirements of the "Standard Specifications for the Portland Cement", serial designation C-150 of the ASTM and shall be Type as per soils report, and, except where transit-mixed concrete is to be employed, shall be delivered to the job site in original packages adequately protected from the weather during storage.

2.04 INTERACTIVE WATER FEATURE CONCRETE:

Concrete shall contain a crystalline waterproofing admix, Xypex.

Concrete shall be an exposed aggregate finish using the Dayton "TOPCOAT" acid-washing method. Submit aggregate mix to design team. Surface finish shall be non-slip.

Concrete shall be colored with integral Davis color as specified on the plans sets.

The sub grade shall be thoroughly wetted before concrete is placed.

The concrete shall have a water-reducing retarder added, Plastiment or equal, at a minimum rate of two fluid ounces per bag of cement, per manufacturer's recommendations according to the day time temperatures. Exact proportions of four to eight fluid ounces shall be determined by test at the job site. The concrete mix shall contain an average of 3% air entrainment, with no more than a 3½" slump, and a minimum 28 day strength of 4,000 p.s.i.

After finishing, the floor shall be covered with plastic sheeting for a period of five days. No curing compound will be allowed.

2.05 OTHER CONCRETE:

Furnish and place any required concrete for anchor blocks, water features, etc. as indicated on drawings. Provide thickened slab under play feature supports as required by the manufacturer.

Concrete shall be a mix developing a minimum strength of 4,000 PSI at 28 days.

2.06 INITIAL CURING:

All structural concrete shall be kept continuously wet for a minimum period of seven days, or as necessary to insure proper initial cure or adequate coverings with plastic sheeting through the curing period. No curing compound will be allowed.

2.07 INTERACTIVE WATER FEATURE DIMENSIONAL TEST:

Check size and dimensions of interactive water feature for deviations from design drawings as directed by Architect. Corrections shall be made if directed.

2.08 INTERACTIVE WATER FEATURE APPEARANCE:

Interactive water feature shall be free from cracks, honeycombing, spills, voids, and other defects. The interactive water feature shall have a non-slip surface.

2.09 INTERACTIVE WATER FEATURE DECK EXPANSION JOINT and JOINT SEALER:

All expansion joint material, joint sealer primer and joint sealer primer shall be resistant to the effects of chemically treated water.

The joint material shall be Deck-O-Foam, by W.R. Meadows, sized per the requirements of the architect. Joint sealant shall be either two-part Deck-O-Seal 125 (polysulfide sealant) or two-part Deck-O-Seal Gun Grade (polysulfide sealant). Color selection by the architect. Standard colors are Dura-White, Stone Gray and Desert Tan. Jet Black and Redwood are available upon special order).

Before applying the joint sealer, apply a two-part P/G epoxy primer by W.R. Meadows per the manufacturer’s recommendations.

2.10 TILE:

Acceptable tile manufactures for deck markings are In-lays, Inc. or approved equal. All tiles shall be resistant to chemical attack, shall have a water absorption of 0.5% or less, resist fading, and be designed for use in an interactive water feature environment.

All setting and laying of tile, and all materials and labor required for completion of the tile work shall be in accordance with the latest basic specifications issued by the Tile Manufacturer's Association, except as otherwise noted herein or shown on the drawings. All work shall be performed by mechanics skilled in the trade. Tile shall remain whole and firmly in place. Tile shall be placed

flush and even with each other, parallel to the deck surface, and shall have clean cuts. Grout lines of tile shall line up unless otherwise approved by the Architect. Tile shall be placed flush and even with each other within a tolerance of plus or minus one-eighth inch. All tile shall be frost-proof.

Provide waterproofing compound to provide watertight finish. All waterproofing, adhesives, tiles, and grouts used in the interactive water feature shall provide a water tight finish and shall be suitable for use in freeze/thaw climates.

Setting materials:
Flexible acrylic Latex Portland Cement Mortar: Mapei – KERABOND/KERALASTIC, white color, two component flexible mortar system conforming to ANSI A118.10 standards or approved equal.
Flexible Fast Setting Latex Hydraulic Mortar: Mapei – KER 318 GRANI/RAPID, white color, two-component, flexible latex hydraulic thin-set mortar conforming to ANSI A118.10 standards or approved equal.

Grouting materials:
Sanded Tile Grout: Mapei – KER200 polymer-modified sanded Portland cement grout conforming to ANSI A-118.6 standards or approved equal.
Fast Curing Sanded Tile Grout: Mapei – KER 700 Ultra/Color polymer-modified hydraulic sanded tile grout conforming to ANSI 118.6 standards or approved equal.

2.11 WATER FEATURE ROCKS:

Large rocks and boulders are to be selected by the landscape architect. All rocks and boulders shall conform to the regulations as set forth by the local health department. The placement of the rocks shall be under the direction of the landscape architect for size, placement and orientation.

PART 3 - INTERACTIVE WATER FEATURE PIPING:

3.01 EXCAVATION, BACKFILL, PIPE TESTING AND LINE FLUSHING:

Make required pipe trench excavations and backfill. No backfilling of pipe trenches shall be made until the piping has met the proper pressure test. Backfilling of trenches shall be done in accordance with the requirements specified in Section 2. All interactive water feature feature piping, circulation system piping and water piping shall be given pressure tests. All piping leading to and from the splash pad / river feature shall be flushed clean of oil, pipe cuttings, and other foreign matter. Any stains on the interactive water feature finish due to foreign material from the piping are not acceptable and any stained surfaces shall be cleaned at the Interactive water feature Contractor's expense.

3.02 FRESH WATER LINES:

Reduced-pressure, backflow-prevented, potable water lines and valves shall be installed from the juncture point with the potable water lines as shown on the plumbing drawings to proper locations in the interactive water feature filter equipment room as shown on the drawings. See Plumbing Division for material types to be used, point of connections, additional requirements.

The fresh water lines and manual shut off-valve shall be installed to the point of connection shown on the plumbing drawings by the Plumbing Contractor. Interactive water feature contractor shall extend piping from this point of connection to locations noted on the interactive water feature drawings. All fresh water piping shall be completed in accordance with Plumbing Division. Interactive water feature contractor is responsible for coordination with the Plumbing contractor to assure installations are provided and properly located.

3.03 INTERACTIVE WATER FEATURE PIPING:

Furnish and install all piping, pipe fittings, and valves from the interactive water feature fittings to the junctures indicated on the drawings. Make necessary pipe trenching and do necessary backfilling, including sand bedding at 95% compaction, as required for piping and other work as hereunder specified to complete the interactive water feature plumbing installation as shown on the drawings and in the specifications. Piping is shown on drawings in diagrammatic form (U.O.N.) to indicate work to be done rather than show exact routing and locations. Make use of all data in contract documents, verify against developed field conditions, and install work in an orderly arrangement in a manner to overcome structural and mechanical interference. Piping and necessary valves should be placed such that the interactive water feature can be winterized (including all piping and components). All piping and components shall be installed in a manner to avoid freezing. Also see division 2 for additional pipe trenching requirements

3.04 OUTLETS AND RETURN PIPING:

All feature piping for the interactive water feature supply (return) piping and fittings shall be NSF approved Schedule 80 PVC as shown on the drawings. All interactive water feature circulation piping and fittings to and from the balancing tank shall be NSF approved Schedule 40 PVC as shown on the drawings. All piping shall be as manufactured by R & G Sloane, Spears, or approved equal. All piping under or in interactive water feature shall be fully encased in concrete unless otherwise noted on the drawings. All piping connections shall be solvent welded. Gasketed pipe is not acceptable.

If building codes, fire codes, or other codes require CPVC or other type of piping through certain building spaces, the most stringent code shall govern, and the contractor shall provide the type required by code. The contractor shall notify interactive water feature engineer to verify compatibility with other materials and chemicals being used in the system.

All piping to and from the interactive water feature shall be hydrostatically tested at 50 p.s.i. before any pipe is concealed. Pipe shall be maintained tight at this pressure for a minimum of 24 hours. All piping shall be maintained tight with 5 p.s.i. of pressure throughout the remaining construction period.

Pressure Tests: Hydrostatically test all water piping systems. Do not pneumatically pressure test. Conduct tests in accordance with ANSI B31.1 and as follows: Test piping systems after the lines have been cleaned as herein before specified. Test the piping system at a pressure of 50 p.s.i. with water not exceeding 100 deg. F. Before tests, remove or isolate gages, traps, and other apparatus subject to damage by test pressure. Install calibrated test gage in system to observe any loss of pressure. Close off system and retain required pressure for one hour minimum and then inspect all joints and connections for leakage. Maintain specified pressure in all lines for a minimum of 24 hours. Maintain 5 p.s.i. pressure in all lines throughout the remaining construction period. Each

trade should verify the pressure maintenance before and after completion of work to insure piping integrity. All failures shall be satisfactorily repaired and the complete test performed again. Contractor shall log and maintain records of pressure test on site and maintained in contractors job file. Such logs shall be presented to engineer upon request.

Test Gages: Pressure test gages shall be currently certified as being accurate to within 1 percent of their full scale. Use gages with maximum scale between 1-1/2 and 2 times the test pressure.

Factory Tests: Factory test prefabricated piping sections and fittings to ensure compliance with this specification and to prove integrity of joints.

General: The Interactive water feature Contractor shall furnish all equipment and apparatus required for performing the inspections and tests, except water supplied by Owner, and shall correct all defects and repeat respective inspections and tests, as required for final approval.

3.05 FILTER ROOM PIPING AND FITTINGS:

The filter room piping shall be Schedule 40 PVC, Schedule 80 PVC, or CPVC with flanged PVC or CPVC fittings. All metal bolts, connectors, and other fasteners shall be stainless steel. All PVC piping connections shall be solvent welded and flanged. Gasketed pipe is not acceptable.

Filter room piping shall be identified by tagging and/or color coding. Piping flow shall be indicated by directional arrows on the piping.

3.06 CHEMICAL SOLUTION PIPING:

Chlorine and hydrochloric acid piping shall be Schedule 80 PVC pipe and fittings (solvent weld). Chorine and hydrochloric acid tubing and fittings shall be polypropylene.

All Chemical piping that runs underground (or in inaccessible locations) shall be double containment piping. Underground or inaccessible double-containment piping shall be oversized and use sweep elbows to allow chemical tubing to be pulled through the piping in the future.

Chemical solution piping and tubing contents shall be identified by color coding and/or tagging. Flow direction of chemical solution piping and tubing shall be provided. The piping and tubing identifications shall be in compliance with all applicable requirements of local codes, health department, the IFC and ASME A13.1.

Chemical solution piping shall be installed with clip supports or hangers at 4’-0” c.c. max spacing. Chemical solution tubing shall be anchored to wall or ceiling @ 3’-0” c.c. max.

3.07 VALVES:

All valves for interactive water feature piping 3" and smaller shall be PVC ball valves, ASAHI American “Omni” or approved equal.

All valves for chemical piping 3” and smaller shall be PVC ball valves, ASAHI American “Omni” or approved equal.

All valves 4" and larger shall be butterfly valves ASAHI American “Pool Pro” or approved equal. Butterfly valves are to be manufactured of PVC with reinforced disks with stainless steel shafts. Valves shall be capable to handle hydrostatic pressures up to 100 p.s.i. without leaking. Valve stems and extensions shall be of stainless steel with adequate support.

Valves 4" and 6" shall be lever operated. Valves 8" and above shall be gear operated (except as noted on the plans). Valves 8" and above which are located in balancing tank shall be gear operated with handle extensions and the gear located above the concrete lid of the balancing tank.

All check valves shall be Spears thermoplastic (PVC or CPVC) check valves, flanged type, with internal parts compatible with chlorine / chemically treated water.

Pressure relief/sustaining valves shall be non-corrosive and resistant to treated water. Provide 0-75 psi adjustment range.

All flange bolts and nuts shall be 304 stainless steel. All components in the balancing tank shall be PVC and stainless steel as indicated on the drawings or in the specifications.

Identify valves by tagging and/or color coding.

3.08 MAKING UP PIPE:

All pipe shall be cleaned of scale, sand, dirt, and rust before installation. The ends of threaded pipe shall be reamed out full size, threads cut with new dies, and not more than two full threads shall be left exposed when the joint is made up.

Offsets shall be made with fittings. Pipe shall not be bent at any time except where copper water tubing, Type L is used. Offsets may be bent, but the radius of the bend must be such that no deformation of the tubing shall occur.

Joints for PVC Pipe: PVC pipe shall be cut square with a pipe cutter or a sharp saw. Free the joint of the feathered edged and ream to full size as necessary. Apply a cleaner and a liberal coat of solvent to the outside of the pipe and in the fitting making sure that the coated area is equal to the depth of the fitting socket. Insert the pipe quickly into the fitting and turn the pipe approximately 15 degrees so that the fitting does no push off the pipe. Do not interrupt the solvent welding of the joint once the solvent is applied. Wipe off all excess solvent to prevent weakening of the joints. Be sure that in going to the next joint that the pipe is not twisted, disturbing the last completed joint.

Joints in copper water tubing shall be thoroughly cleaned and made tight with a good grade of tin-lead solder making sure that the entire joint is properly sealed throughout its full area.

Joints in screw piping shall be made of the Grinnell Stainless Pipe Joint Cement.

3.09 PITCH OF PIPES:

Horizontal drainage lines shall be supported to a uniform slope. All piping shall be installed so as to avoid unnecessary turns in order that friction loss may be kept at a minimum. Piping shall be installed in order to prevent air traps. The minimum slope for all suction and return piping shall be a minimum 0.25% pitch.

3.10 PIPE HANGERS AND SUPPORTS:

The pipe hangers shall be adjustable B-line Figure B3105 stainless steel or equal. Pipe supports shall be adjustable B-line Figure B3092 stainless steel saddle support with Figure B3088T stainless steel stand or approved equal. Pipe hangers and supports shall be constructed of stainless steel and shall be located as needed to adequately support all piping and components. Interactive water feature contractor may fabricate special hangers or supports subject to approval of the Architect. PVC piping shall not be unsupported for lengths in excess of four (4) feet. Provide adequate supports and spacing as to avoid pipe sagging between supports and to support against the effects of water hammer. All interactive water feature piping larger than 3" must be supported for seismic loads in accordance with the International Building Code. The Interactive water feature contractor is responsible for the design and installation of all seismic bracing. Design of seismic bracing shall be submitted to the building department as a deferred submittal if required by the building inspector.

3.11 ASSEMBLY AND INSTALLATION - EQUIPMENT:

Furnish, assemble, and install a complete operational piping, filter circulation, chemical feed and sanitizing system and other mechanical equipment for interactive water feature as shown on drawings, and in accordance with the instruction furnished by the manufacturer supplying such equipment. Drawings indicate in diagram form the desired arrangement of the principal apparatus, piping, and equipment, and shall be followed as closely as practicable, exercising care in the work to secure proper head room and space conditions and a neat and workmanlike arrangement of piping and valves.

Furnish suitable tags for marking all valves. Provide identification and signs as required for the valves for the chemical solution piping per requirements of the International Fire Code, Section 27.

Obtain complete instructions for installing and operating all mechanical equipment. No equipment shall be put into operation without the assistance of a qualified operator familiar with the operation of such equipment.

PART 4 - INTERACTIVE WATER FEATURE FITTINGS:

4.01 TRENCH DRAIN FRAME AND GRATES (FITTINGS):

Trench frames and grates shall be CAST BRONZE unless otherwise noted on drawings. Secure all grates/covers to the frame with 304 stainless steel screws a minimum of 1 3/16" in depth. These screws shall be tamper proof. Submit patterns selections to the architect for selection.

4.02 BALANCING TANK INLET FITTINGS:

The balancing tank inlet fittings shall be custom assembled using PVC pipe per the details on the drawings. The drilled inlets openings shall be sized per plans.

PART 5 - INTERACTIVE WATER FEATURE CIRCULATION / FEATURE EQUIPMENT:

5.01 ASSEMBLY AND INSTALLATION:

Furnish, assemble, and install a complete operational pumping, piping, filter, chemical feed and chlorination system and other mechanical equipment for the interactive water feature as shown on the drawings, in accordance with the instructions furnished by the manufacturer supplying such equipment. Install seismic anchorage for piping, filters, chlorine storage tanks, acid storage tanks, and any other items indicated on drawings. Filtration and Chemical System Equipment shall be NSF listed. All metal connectors, bolts, washers, and other fasteners or anchors shall be stainless steel. The Interactive water feature Contractor shall be responsible for design installation of all seismic bracing for interactive water feature equipment. Design to be submitted as a deferred submittal as required by building official.

Drawings indicate in diagram form the desired arrangement of the principal apparatus, piping, equipment, and shall be followed as closely as practicable, exercising care in the work to secure proper head room and space conditions and a neat and workmanlike arrangement of piping and valves. The filtration system shall be completely ready for operation including all piping as shown on the drawings. Mark all lines with flow direction indicators. Furnish suitable tags for marking all valves.

Obtain complete instructions for installing and operating all mechanical equipment from the manufacturer. No equipment shall be put into operation without the assistance of a qualified operating technician familiar with the operation of such equipment.

5.02 ELECTRICAL CONNECTIONS:

The Interactive water feature Contractor shall furnish and install all interactive water feature equipment / electrical motors, low voltage interlocks and control wiring, etc., as required and specified, except as specifically noted otherwise for equipment described in this section of the specifications.

The Electrical Contractor shall furnish and install all panels, starters, start-stop stations, disconnects, junction boxes, line voltage interlocks and the running of conduit and wiring to such motors, etc., and their connections, and furnishing such electrical equipment as specified and shown on the drawings. The Electrical Contractor shall be responsible for proper calibration, adjustment, and arrangement of terminal connections of wires to the control equipment.

The Electrical Contractor shall provide conduit and wiring from the interactive water feature activators to the controllers located in the equipment room. The Interactive water feature contractor shall make the low voltage connections.

The circulation pump shall be electrically interlocked with the chemical feed system and the UV disinfection system control panel. Coordinate with electrical drawings and electrical contractor to assure that this work is included in the electrical contractor’s scope of work. Any deficiencies should be communicated to the Architect and Engineers prior to bids being submitted.

The Interactive water feature Contractor shall coordinate with the electrical drawings and the Electrical Contractor to insure that all required components of the work are included and fully understood so that there are no deficiencies. No additional cost shall accrue to the Owner as a result of lack of coordination. The Interactive water feature Contractor and the Electrical Contractor shall complete the work so as to provide a complete operating system with no additional cost to the Owner for field wiring required related to the equipment.

5.03 BALANCING TANK:

The water-storage balancing tank shall be a cast in place per the specs of the design team. The concrete tank shall contain a Xypex admixture, per Xypex manufacturer's recommendations. Tank shall include manhole hatch (as specified on plans) and plastic ladder rungs for access. Contractor shall coordinate the sizes and number of penetrations that will be either sleeved or field core-drilled through the walls of the tank. The concrete construction of the tank is not part of this specification section. See responsibilities of General Contractor listed elsewhere in this section.

The interactive water feature contractor shall line the interior of the balancing tank with two coats of waterproofing. Prior to the application of waterproofing, the Interactive water feature Contractor shall notch any shrinkage cracks ¼" X ¼" and seal with W.R. Meadows "Deck-o-seal" two-part gun grade. Interactive water feature contractor is responsible to coordinate with the General contractor to assure that the concrete finishes of the balancing tank and backwash pit are adequate for installing waterproofing in accordance with manufacturer's instructions.

The interactive water feature contractor shall provide the required sleeves, couplings, and O-rings and shall coordinate with the General Contractor as to their required locations and elevations. The Interactive water feature Contractor is responsible for the installation of all mechanical seals around pipes and for assuring a watertight seal around all penetrations where mechanical seals are not required on the drawings. The General Contractor is responsible for the installation of all pipe sleeves, couplings, and O-rings that require installation prior to placement of concrete. The interactive water feature contractor shall provide to the general contractor all sleeves, PVC couplings with O-rings, and seals to be installed in the building wall as required and other locations shown on drawings. If the Interactive water feature Contractor fails to coordinate this work with the General Contractor and provide the required sleeves, couplings, and O-rings and the required sleeves are not installed, the Interactive water feature Contractor is responsible for concrete removal and installation of the sleeves or for any core-drilling required (only if allowed by structural engineer). If the General Contractor fails to install the sleeves, couplings, and O-rings as coordinated by the Interactive water feature Contractor, the General Contractor is responsible for concrete removal and installation of the sleeves or for any core-drilling required (only if allowed by structural engineer).

5.04 MODULAR / MECHANICAL SEAL:

The mechanical seal shall consist of rubber links shaped to continuously fill the annular space between the pipe and the balancing tank and pump vault wall openings. Seal elements shall be constructed of EPDM rubber. The pressure plates shall be molded of glass reinforced nylon. Hardware shall be 316 stainless steel. When the pipe seal can be set prior to construction of the wall, utilize sleeves with integral hollow, molded water-stop ring 4 inches larger than the outside diameter of the sleeve itself. Sleeves shall be made of HDPE thermoplastic with reinforcing ribs (Century Line or equal).

5.05 CIRCULATION AND FEATURE PUMPS:

All filter circulation pumps shall be electrically interlocked with their associated equipment per part 5.02 of this specification. Coordinate with electrical drawings and electrical contractor to assure that this work is included in the electrical contractor's scope of work. Any deficiencies should be communicated to the Architect and Engineers prior to bids being submitted.

Pumps: >/= 5 HP:

Pumps 5 hp and greater shall be premium efficiency compatible to be used with a VFD. Pump shall be non-corrosive, plastic commercial grade. Pumps shall be close coupled, self-priming, complete with an integral hair an lint strainer. Pump shaft shall be stainless steel. Nuts and bolts shall be stainless steel. Provide pumps with sealed ball bearings, continuous duty-rated, 3450 RPM, open drip-proof design, with an automatic reset for thermal overload protection.

5.06 VARIABLE FREQUENCY DRIVE:

A. General:

The manufacturer of the VFD shall demonstrate a continuous period of manufacturing and development of VFD's for a minimum of 35 years.

An Automatic Energy Optimization (AEO) selection feature shall be provided in the VFD to minimize energy consumption in variable torque applications. Feature shall optimize motor magnetization voltage. This feature shall dynamically adjust output voltage in response to load, independent of speed. Output voltage adjustment based on frequency alone is not acceptable for single motor VT configurations.

Switching of the input power to the VFD shall be possible without interlocks or damage to the VFD at a minimum interval of 2 minutes.

Switching of power on the output side between the VFD and the motor shall be possible with no limitation or damage to the VFD and shall require no additional interlocks.

An Automatic Motor Adaptation (AMA) function shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to spin the motor shaft or decouple the motor from the load to accomplish this optimization. Additionally, the parameters for motor resistance and motor reactance shall be user-programmable.

The VFD shall have temperature controlled cooling fans for quiet operation, minimized internal losses, and greatly increased fan life.

B. Protective Features:

VFD shall have sealed electronics which used a heat sync to extract heat from drive, then cooled by a fan which also is connected to its own VFD. The drive's electronics do not come in contact with ambient air, therefore a ventilation fan and filter is unnecessary. Drives that incorporate the use of a ventilation fan and filter shall not be equal.

VFD shall have input surge protection utilizing MOV's, spark gaps, and Zener diodes to withstand surges of 2.3 times line voltage for 1.3 msec.

VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD.

VFD shall have built-in DC Coils to reduce voltage ripple and increase capacitor life. Drives without DC Coils shall provide a 5% input line reactor.

Automatic "No-Flow Detection" shall be available to detect a no-flow situation in pump systems where all valves can be closed. This shall be functional in closed loop control or when controlled by an external signal.

Dry-pump detection shall be available to detect if the pump has run dry and trip the drive. A timer shall be included to prevent nuisance tripping.

End-of-Pump curve detection shall stop motor when the pump is operating outside of its programmed pump curve.

VFD shall include current sensors on all three-output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.

VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable and a warning will be exported during the event. Function shall reduce switching frequency before reducing motor speed.

VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. Speed can be reduced, but not stopped.

C. Interface Features:

VFD shall provide an alphanumeric backlit display keypad (LCP) which may be remotely mounted using standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.

VFD Keypad shall offer an INFO key that, when pressed, shall offer the contents of the programming manual for the feature that is currently in the display. The contents shall explain the feature and how the settings can be made

Keypad shall provide an integral H-O-A (Hand-Off-Auto) and Local-Remote selection capability, and manual control of speed locally without the need for adding selector switches, potentiometers, or other devices.

VFD Display shall have the ability to display 5 different parameters about the VFD or load including: GPM, amps, RPM's, KWh, PSI, savings calculator, output voltage, or other values from a list of 92 different parameters.

A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

Two-level password protection shall be provided to prevent unauthorized changes to the programming of the VFD. The parameters can be locked via a digital input and/or the unit can be programmed not to allow an unauthorized user to change the parameter settings.

A quick setup menu with factory preset typical parameters shall be provided on the VFD to facilitate commissioning. Use of macros shall not be required.

A digital elapsed time meter and kilowatt hour meter shall be provided in the display.

VFD shall offer as standard an internal clock. The internal clock can be used for: Timed Actions, Energy Meter, Trend Analysis, date/time stamps on alarms, Logged data, Preventive maintenance, or other uses. It shall be possible to program the clock for Daylight Saving Time / summertime, weekly working days or non-working days including 20 exceptions (holidays etc.). It shall be possible to program a Warning in case clock has not been reset after a power loss.

D. Drive Inputs

All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.

There shall be six fully programmable digital inputs for interfacing with the systems external control and safety interlock circuitry. Two of these inputs shall be programmable as inputs or outputs.

The VFD shall have two analog signal inputs. Inputs shall be programmable for either 0 -10V or 0/4-20 mA.

One programmable analog output shall be provided for indication of a drive status. This output shall be programmable for output speed, voltage, frequency, motor current and output power. The analog output signal shall be 0/4-20 mA.

The VFD shall provide two user programmable relays with 75 selectable functions. Two form 'C' 230VAC/2A rated dry contact relay outputs shall be provided.

Drive shall be able to connect to auto backwash controller and automatically change to set backwash speed when called for.

A digital flow meter with 4-20mA output can be connected to drive, and GPM may be displayed on drive screen.

Drive shall be capable of using pressure transducers to monitor and control programs using these PSI inputs.

E. Operation:

Four complete programming parameter setups shall be provided, which can be locally selected through the keypad or remotely selected via digital input(s), allowing the VFD to be programmed for up to four alternate control scenarios without requiring parameter changes.

Drive has up to eight programmable speeds that can be set to facility specific parameters. Separate speeds for backwash, off hours, or seasonal conditions may be initiated by relay input, sensor input, time, or manually. Drive may also send signals out to protect other mechanical equipment such as heaters during backwash.

Drive shall have ability to communicate remotely via Ethernet, Mod Bus, and RS 485 connections. Keypad may also be mounted remotely.

Drive has the ability to incorporate a fused bypass or circuit breaker bypass option. If activated, power will feed directly to the motor of the circulation pump and run at full speed.

F. Service Conditions:

The ambient operating temperature of the VFD shall be -10ºC to 50ºC (14 to 122°F), with a 24 hour average not to exceed 45ºC. Storage temperatures shall be -13° F (-25° C) to149/158° F (65/70° C).

0 to 95% relative humidity, non-condensing.

Elevation to 3,300 feet (1000 meters) without derating.

VFD's shall be rated for line voltage of 525 to 690VAC, 380 to 480VAC, or 200 to 240VAC; with +10% to -15% variations. Line frequency variation of ± 2% shall be acceptable.

G. Quality Assurance:

The manufacturer shall be both ISO-9001 and ISO-14001 certified.

To ensure quality and minimize infantile failures on the jobsite, all VFD's shall be completely tested by the manufacturer. The VFD shall operate a dynamometer at full load and speed under elevated temperature conditions.

H. Start-up, Support and Warranty

A factory-authorized service technician shall perform start-up on each drive. Start-up costs provided with the bid shall include time and travel for the estimated number of visits required, but shall not be less than at least one half-day with travel. Additional labor or return trips to the site shall be billed at Danfoss' published straight-time rates. Upon completion, a start up service report shall be provided.

A 1-year on-site warranty shall be provided such that the owner is not responsible for any warranty costs including travel, labor, parts, or other costs for a full 1 years from the date of installation. An additional warranty of up to 6 years is offered as an option. The cost of the warranty shall be included in the bid.

Technical questions regarding drive installation and functions may be answered by contacting the Dan Foss Tech Support department, available 24 hours a day.

5.07 BASKET STRAINER:

Basket strainers shall be manufactured by Hayward. Strainer construction shall be PVC. Provide complete with optional Type 316 stainless steel, 20 mesh basket. Minimum 100 psi pressure rating.

5.08 FILTERS (MANUAL BACKWASH):

The filter system shall be a pressure high-rate, permanent media filter equipped with a manual high-flow multi-port valve for backwashing filter.

The filter system shall be the standard cataloged product of a company regularly engaged in the manufacturer of water filtration equipment with a minimum of five years of experience in manufacturing high-rate filters for public and institutional applications.

The filter system shall be of the type suitable for a single grade of media, and shall be listed by the National Sanitation Foundation for a maximum flow of 20 gpm per square foot of filter area with a maximum 3 p.s.i. pressure loss across any filter tank at a flow rate of 20 gpm per square foot.

The filter system shall consist of a filter tank with internal distribution and collection systems, operating valves, high-flow multi-port backwash control valve, pressure gauge, and air relief system.

The filter media shall be of a single grade and consist of uniformly graded, angular shaped, crushed silica sand which shall be free of limestone or clay. Filter media shall be Grade #20, effective size .45 millimeter with a uniformity coefficient of 1.5 maximum.

Once installed, the system shall be capable of withstanding, without damage or leakage, a 24-hour hydrostatic pressure test at a static load of at least 50 pounds per square inch.

5.09 FLOW METER:

Sensor-Powered Flow Monitor & Sensor
Flow meter shall be complete with sensor-powered remote flow indicator, polypropylene flow sensor and sensor installation fitting. The interactive water feature shall utilize the Chemical Controller as its circulation flow meter.

Flow meter sensor shall be installed downstream from the filter and upstream from the chlorine and acid injection point. Flow meter sensor shall be installed with the manufacturer recommended straight distances of pipe both upstream and downstream from the flow meter.

5.10 AUTOMATIC CHEMICAL CONTROLLER:

A. GENERAL

The water chemistry control system shall provide continuous monitoring and control of sanitizers (standard ORP sensor), oxidizers, pH, temperature, system flow rate monitoring, total dissolved solids (TDS), turbidity, chemical inventory levels, surge tank water level, system pressures, and water chemistry balance calculations. Installation of the system shall be per the manufacturer's specification and no exceptions shall be allowed. A factory trained / authorized representative shall provide training to the owner.
Requests for substitutions for the specified make and model will not be considered unless equal to the specified system in every respect. Requests for substitutions must include a sample controller with all specified features; complete documentation relating to all the specified features; and manufacturer's sales literature, engineering drawings and, installation, operation, and maintenance manuals. Failure to provide these or any other information necessary to confirm that all specified features are provided will be cause for rejection of substitution request.

B. CERTIFICATIONS

The controller shall carry the following product certifications:

- UL 61010-1
- (CSA) C22.2 Number 61010-1

C. SENSORS

STANDARD SENSORS

The controller shall come with pH, ORP, and temperature sensors meeting the following requirements:

1. pH

The controller shall provide a measurement of pH by utilizing a sensor with the following characteristics:

- 0-14 sensing range
- ABS body with 1/2" NPT process connection
- Minimum of 32 millimeters of inorganic electrolyte gel. Organic electrolytes, susceptible to breakdown in the presence of strong oxidants, shall not be considered equal.
- A porous Teflon liquid junction to provide a stable, low impedance reference contact, and to prevent fouling and clogging of the liquid junction
- A silver / silver chloride (Ag / AgCl) reference element
- A general purpose glass membrane pH sensing element
- Operating temperature range of 32 to 136 degrees F (0 to 80 degrees C)
- Operating pressure range of 0 to 100 psiG

The controller shall continuously monitor, display and data log pH with 0.1 to 0.01 resolution (programmable).

2. ORP

The controller shall provide a measurement of ORP by utilizing a sensor with the following characteristics:

- -1000 to +1000mV sensing range
- ABS body with 1/2" NPT process connection
- Minimum of 32 millimeters of inorganic electrolyte gel. Organic electrolytes, susceptible to breakdown in the presence of strong oxidants, shall not be considered equal.
- A porous Teflon liquid junction to provide a stable, low impedance reference contact, and to prevent fouling and clogging of the liquid junction
- A silver / silver chloride (Ag / AgCl) reference element
- A solid platinum or solid gold ORP sensing element with a minimum of 1 cm2 surface area. Platinum plated or gold plated sensing elements, which are susceptible to abrasives, shall not be considered equal
- Operating temperature range of 32 to 136 degrees F (0 to 80 degrees C)
- Operating pressure range of 0 to 100 psiG

The controller shall continuously monitor, display and data log ORP with 1mV resolution.

3. Temperature

The controller shall provide a measurement of water temperature by utilizing a sensor with the following characteristics:

- 32 to 212 degrees F (0 to 100 degrees C) sensing range
- 2 wire, 100 Ω resistive temperature detector (RTD) with a 0.00385 Alpha

The controller shall continuously monitor, display and data log temperature with 1 degree F resolution.

OPTIONAL 4-20mA SENSORS

The controller shall be capable of reading a total of four (4) of the following optional 4-20mA output sensor, or two (2) if the conductivity / TDS sensor is used.

Provide the following Optional 4-20mA Sensor:

4. Liquid Level Sensor

The controller shall provide measurement of liquid levels for backwash holding tank by utilizing liquid level sensor(s) with the following characteristics:

- Field configurable sensing range from 3 ft to 16 ft
- Field calibration for various tank levels, shapes and sizes
- Non-contacting sensing elements enclosed in PVC

The controller shall continuously monitor, display and data log liquid level(s).

D. USER INTERFACE

1. Standard Display

The standard display shall be a backlit transflective LCD with 14 line. 40 alpha/numerica graphical characters that will continuously display information related to the following:

- All installed sensor readings
- Set points, with current control status
- All active alarms, including time activated
- Smart menus with integrated on-screen help.

Contrast adjustment of the backlit LCD shall be provided through clearly marked keys on the front-panel without the need for access to internal controller circuitry. After initial adjustment, controller shall monitor internal temperature and automatically adjust contrast to prevent LCD blackout in extreme ambient temperature conditions. Controllers that do not include front-panel contrast adjustment and automatic temperature compensation shall not be considered equal.

The standard user interface shall include single-touch access to Set Points, Relay Modes, Calibrations, Menu access, and Reset Fail/Safes. An alphanumeric keypad shall be provided for ease of system configuration.

E. CONTROL FUNCTIONS

1. Water Chemistry

A. pH Control: The controller shall continuously control pH. Chemical feed shall be configurable for feed-up, feed-down, or dual feed and either on/off or time-based proportional feed.

B. Sanitizer Control: The controller shall continuously control sanitizer based upon the ORP reading, the amperometric sensor, or both with a bracketed control program. Chemical feed shall be configurable for either on/off or time-based proportional feed.

C. Bracketed Sanitizer Control: With the amperometric ppm sensor, the controller shall be configurable for bracketed sanitizer control; The bracketed control algorithm shall allow either the ORP or ppm setpoint to be chosen as the primary control point, while using other parameter to create a secondary boundary (min and max settings) that must be maintained in addition to the primary control point.

D. Sanitizer Booster Feed: The controller shall have a sanitizer booster program with selectable ORP and/or ppm set points with separate ending set points, allowing the option of the booster sanitizer to control to a lower set point while the primary system can recovers.

E. Ozone / UV Control: The controller shall provide feed-up control of an ozone or UV system based upon ORP and/or ppm set points. A Fireman Cycle feature shall turn off the Ozone/UV relay 0 to 60 minutes (settable) prior to backwash initiation or recirculation pump shutdown. The Ozone/UV control algorithm shall include an Energy Conservation mode, with on/off set time and secondary set point.

F. Super-chlorination: The controller shall have a programmable superchlorination function, based ORP or ppm superchlor setpoint, which is triggered manually.

G. De-chlorination: The controller shall have a programmable dechlorination function, based upon ORP or ppm dechlor setpoint, which is triggered either manually or by the completion of the superchlorination function.

H. LSI & RSI: The controller shall compute the Langelier Saturation Index and the Ryznar Saturation Index based upon current inputs and the Ca Hardness and Alkalinity entered by the operator.

2. Expanded

A. Flow Monitoring: The controller shall continuously monitor, display, and datalog system flow, maintaining a total flow volume. A low flow alarm shall be operator settable, which can be programmed to disable chemical feeds.

B. Surge Tank Monitoring: The controller shall continuously monitor, display, and data log surge tank levels.

C. Autofill: The controller shall automatically control a water makeup relay to add makeup water to maintain interactive water feature level set point, based upon surge tanks (or equivalent) level, with an overfill delay feature. The controller shall provide a programmable alternate set point (4 event 28 day timer).

D. Sensor Wash: The controller shall include a programmable sensor wash with start and end time, feed duration, and number of cycle to allow multiple feed cycles per day.

3. Energy Conservation

A. Alternate Setpoints: The controller shall have alternate Sanitizer, Heater and Autofill set-points, based upon a 4 event 28 day timer.

B. Energy Conservation Mode: The controller shall have the capability to disable all mechanical and chemical functions during programmed conservation cycle. The Energy Conservation Mode shall include the ability to periodically monitor and satisfy all operation requirements based upon a programmed time schedule.

4. Main Recirculation Pump

A. On-Off Control with Relay

Controller shall provide the capability to interface to and control a recirculation pump with a programmable relay. The controller shall include the following capabilities, available as appropriate based up on installed sensors and implemented features:

1. Fireman Switch: The following events shall satisfy Fireman Switch timing requirements prior to turning off the recirculation pump:
    a. Energy Conservation Mode (24 hr, 7 day function)
    b. Manual Off
2. Immediate: The following events immediately turn off recirculation pump, regardless of Fireman Switch timing requirements:
    a. Surge Tank Level Low Alarm: Turn off pump immediately (surge tank is almost empty)
    b. Strainer Vacuum High Alarm: Turn off pump immediately (possible entrapment)
    c. Emergency Shut Down – Triggered by front panel Emergency Off: Turns off pump immediately (per Operator)

B. Total Dynamic Head (TDH)

Controller shall provide the capability to continuously monitor the Total Dynamic Head (TDH) of the main recirculation pump, directly calculated by the controller from recirculation pump influent vacuum and filter influent pressure transducers. TDH shall be displayed on the user interface and recorded in data logs, with user-programmable High and Low TDH Alarm settings.

C. VFD Interface with 4-20mA Signal

Controller shall provide the capability to interface to and control a recirculation pump equipped with a Variable Frequency Drive (VFD) through a 4-20mA signal. The controller programming shall allow the operator to manage the VFD entirely from the water chemistry controller, by providing the following capabilities:

- Programmable setpoint specified as either flow rate, effluent filter pressure, or fixed setting
- Four programmable operator-triggered alternate profiles (“Manual Turndowns”)
- Four programmable scheduled alternate profiles (“Scheduled Turndowns”)
- Override setting for backwash
- Ramp up and ramp down settings
- Minimum output setting

Remote access to current VFD status and all VFD parameters shall be provided through the software provided with controller. The name of each alternate profile shall be changeable by the operator, so that VFD menus and data log entries are intuitive and recognizable by the users of the system.

Systems that do not provide both local and remote management of the VFD through the water chemistry controller shall not be considered equal.

F. CONTROL OUTPUTS

1. Relay Outputs

The controller shall come with a total of 4 integral line or dry contact 5A solid-state relay outputs capable of switching 3A under all normal operating condition, accounting for the effects of the temperature gradient inside the NEMA 4X enclosure. Systems that utilize relays that are not derated mush submit an engineering evaluation justifying the use of relays at their full, optimal condition capacity.

G. SAFETY FEATURES

1. Manual-On Limit

The controller shall have built-in limits to the amount of time any relay control output may forced on (i.e. in Manual On mode). This is an important safety feature to prevent control outputs from inadvertently being left on after service or diagnostics.

2. High / Low Alarm Settings & Control Lockouts

The controller shall have programmable high and low alarm settings for pH, ORP, PPM, temperature, low flow & no flow and chemical overfeed, turbidity, pressure & vacuum, surge tank levels, chemical inventory.

The controller shall have a programmable lockout of sanitizer feed upon pH high or low alarm.

3. No Flow Alarm & Flow Restored Delay

The controller shall activate a No Flow alarm when the dedicated sample stream flow switch indicates there is insufficient flow through the sample stream. This No Flow alarm shall lockout all chemical feed control operations.

The controller shall include a Flow Restored Delay, which shall extend the No Flow lockout user-programmable amount of time after the No Flow alarm ends (i.e. flow is restored). This feature is necessary to assure that the system has valid, stable sensor readings of circulating water prior to making chemical feed control decisions.

4. Feed Limit Alarms

The controller shall trigger a FailSafe alarm if a chemical feed relay remains on longer than the programmable Feed Limit Timer. Chemical feeds shall automatically be disabled if the corresponding reading goes into a FailSafe alarm condition.

5. Emergency Off

The controller shall have a dedicated Emergency Off button on the front panel of the system, which immediately halts all chemical feeds and control outputs when pressed. This feature shall be password protectable, which shall require entry of one of the Security passwords.

6. Safety Shield

The controller shall include a safety shield or other mechanism for allowing fuse replacement without access to high voltage circuitry or wiring.

H. SECURITY

The controller shall have three security password levels: six for operators, two for managers and one for the distributor providing for a history of access identified by the user.

I. DATA LOGGING

The controller shall have 512K battery backed-up RAM for input level recording and events. All input level shall be recorded for 10 to 56 days depending on sample rate (2 to 10 minutes).

The controller shall record and maintain the latest 1100 events over a maximum of 14 days recording all alarms, parameter changes, user logins, and operational cycles related to all control features.

J. LOCAL ALARMS INDICATORS

The controller shall signal all alarm conditions with the following indicators:

- A bright red flashing LED on the front of the controller
- Activation of a master alarm signal provided as a dry contact relay enabling the use of 0-240 VAC alarms
- Each active alarm listed on the LCD display along with time activated

K. REMOTE COMMUNICATION, ACCESS & ALARM NOTIFICATION

1. Ethernet

The controller shall come with a standard, integral 100BaseT Ethernet connection. The controller shall be capable of providing Remote Access via PC with Ethernet connection and Alarm Notification via email or text message via an Ethernet connection to the Internet.

The controller shall come with a 57,600 bps data modem. The controller shall be capable of providing Remote Access via PC with modem connection and Alarm Notification via pager or fax.

2. Remote Access

The controller manufacturer shall provide graphical remote operation software, for interactive connection to the controller from a PC. Remote operation software shall be Windows 7 compatible, and have all of the following operational modes:

A. Site Data Base – for organizing and accessing multiple controllers on site, or at multiple sites.

B. Graphical Operator's Console – to display current readings, setpoints, alarm points, Ryzner in an easy-to-read graphical mode.

C. Data Log Graphing – to review data logs with time-synchronized event data; data log traces shall be configurable, with color and line style selectable by operator

D. Full Menu Tree – All system parameters accessible through a full menu tree interface.

E. Auto-Polling – to allow automatic download of data logs from all controllers in site database.

3. Alarm Notification

The controller shall be capable of providing alarm notification to 8 different recipients. Each recipient shall be individually configurable to receive alarm notification by one of the following methods:

A. Email: Notification of message shall include system type, serial number, location, system ID, and all active alarm including the date and time each alarm was triggered.

B. Text Message: Notification of message shall include system type, serial number, location, system ID, and all active alarm including the date and time each alarm was triggered.

C. Fax: Notification of message shall include system type, serial number, location, system ID, and all active alarm including the date and time each alarm was triggered.

D. Numeric Pager: Notification message shall include callback number. Controller shall acknowledge pager notification when callback is received, and not notify subsequent recipients programmed for pager notification.

L. ENCLOSURE

The controller shall be housed in a NEMA 4X polycarbonate enclosure

M. FLOW CELL

1. PVC Flow Cell

The flowcell shall have a PVC body with two ½“ NPT ports for pH and ORP sensors, two ¼“NPT ports for temperature sensor and sensor wash acid injection, and a clear acrylic front viewing window. The flowcell design shall provide precise sample flow rate and water velocity regulation past the probes. The flowcell shall come provided with PVC ½” isolation ball valves, PVC ¼” wet test valve and standard reed or optional rotary flow switch.

Each flowcell shall be equipped with a pressure-sensing device. The pressure sensor shall consist of a compound pressure/vacuum gauge manufactured in stainless steel, 2 ½” diameter, liquid filled with an operating pressure range of 0 to 60 psig and vacuum of 0 to –30 in./ Hg.

N. WARRANTY, START-UP & MANUALS

Controller shall be covered by a standard manufacturer’s 5 year warranty.

Standard sensors shall be covered by a standard manufacturer’s 2 year warranty.

Optional sensors and flow cell components shall be covered by a standard manufacturer’s 1 year warranty.

The control system shall be provided with on-site start-up, on-site operator training, and 1 year on-site warranty service performed by a representative trained and authorized by the controller manufacturer.

Manufacturer shall supply an Operators Manual describing features and operating instructions.

5.11 CHLORINE FEED AND ACID FEED SYSTEMS (Liquid Chlorine & Hydrochloric Acid):

The chemical feed systems shall consist of peristaltic feed pump(s) as specified on drawings.

The feed pumps shall be interlocked with the chemical controller. This work shall be done by the electrical contractor (except low voltage control wiring shall be installed by Interactive water feature Contractor).

Signs and/or identification markings shall be provided indicating the presence of chlorine and acid at the injection points, storage containers, doors / entry to the chemical storage rooms, and valves as required by all local and national codes.

Provide readily accessible manual valves or automatic remotely activated fail-safe emergency shutoff valves installed on the supply piping and tubing at the point of use and at the tank, cylinder or bulk source. The manual emergency shutoff valves shall be identified and the location shall be clearly visible, accessible and indicated by means of a sign.

5.12 CHEMICAL (CHLORINE & PH CONTROL) FEED PUMPS:

Chemical injector pumps shall be peristaltic type pumps unless otherwise noted on drawings. Output volume shall be adjustable from zero to a capacity in accordance with the size and chemical requirements of the interactive water feature. The pump shall be totally enclosed with no exposed moving parts. Electronics shall be enclosed in a chemical resistant enclosure at rear end of pump. Pumps shall be equipped with an acrylic pump head and 115V/60Hz motor. Sufficient tubing is to

be provided with connections to install properly. Pump shall be mounted on the wall in a location close to the chemical storage containers. Pumps shall be complete with check valve / backflow prevention.

5.13 CHEMICAL STORAGE TANKS:

The liquid chlorine storage tanks shall be for sodium hypochlorite, 12% strength with a specific gravity of 1.20. The acid storage tanks shall be for muriatic / hydrochloric acid, 35% strength.

The chemical storage tanks shall be marked with the appropriate hazard identification signs per requirements of the NFPA 704. Provide identification placards on the entry doors to the storage area as required by the NFPA 704.

5.14 UV DISINFECTION SYSTEM:

Ultraviolet disinfection equipment shall operate within the UVC electromagnetic spectrum emitting wavelengths in the range of 200 nm to 400 nm. This required wavelength will provide constant disinfection / inactivation of bacteria, algae, molds, viruses and destruction of monochloramines, trichloramines and dichloramines.

The UV system shall have an MET or equivalent (ETL, CSA or UL) listing, and be NSF 50 certified.

A. Equipment General Description:
The Ultraviolet System shall be provided in a complete package to include: 316L
Stainless Steel Chamber, Control System located in a NEMA 12 rated panel, Medium Pressure Bulb(s) designed to emit wavelengths within the UVC electromagnetic spectrum, strainer basket, automatic wiper system and Project Commissioning by a Certified Ultraviolet Technician.

Ultraviolet manufacturer to offer unit capability of a Horizontal OR Vertical installation application using state of art design and direct flow through characteristics. Direct flow will be required in order to reduce total head loss through the system. Unit shall be a Multiple Lamp medium pressure system with a bulb range of (2) 1.5kW – (4) 3.3kW power range. Multiple lamp system is required in order to maintain quality disinfection in the event of a single bulb failure.

The Ultraviolet System shall be sized to emit a minimum dose of 60 mJ/cm², with flow rates of up to 972 gpm, within a 8” schedule 80 PVC pipe.

B. Ultraviolet Chamber:
Ultraviolet chamber shall be pressure rated for 100 psi (tested to 150 psi), and pressure drop across the unit will be minimal. The unit shall be constructed of 316L stainless steel to prevent corrosion within the harsh interactive water feature environment. The Ultraviolet chamber shall come complete with the following equipment:

- Ultraviolet Intensity monitor with built-in alarm system to notify operator when output level drops below required level of 60 mJ/cm² The Ultraviolet monitor output shall be transmitted via a 4-20ma signal to the control system. The Ultraviolet probe shall be rated to IP67 and be capable of being removed from the unit without having to drain the system. The lamp output shall be displayed on the control system as an intensity and % output.

• Ultraviolet temperature control system shall be provided to maintain system integrity in the event of flow interruptions to the chamber.
• Ultraviolet chamber shall come complete with annealed quartz sleeve with “O” ring seals for water tightness.
• Chambers shall be complete with ANSI flanges and all ports or vents shall be threaded NPT. The Ultraviolet chamber must be capable of installation in the system so that it re mains full under all conditions.
• The Ultraviolet unit must be complete with appropriate brackets or feet for ease of installation.

C. Ultraviolet Lamp

• Ultraviolet lamp shall be medium pressure high intensity. Lamp shall be designed to emit continuous Ultraviolet wavelengths in the range of 200nm to 400nm. This will pro vide optimal disinfection benefits and destruction of the Monochloramine, Dichloramine and Trichloramine compounds. Lamp must remain unaffected by temperature variance of 0 degrees to 200 degrees Fahrenheit.
• The lamp unit must provide a dose not less than 60 mJ/cm2 at the end of the lamp life and this must be based on the full re-circulating flow rate, not on a side stream treatment.

D. Automatic Wiper System

An automatic cleaning system shall be provided for cleaning of quartz sleeve and Ultraviolet monitor probe. The system shall travel the entire length of the quartz sleeve twice per desired cleaning cycle. Precision molded wiper rings shall be provided to ensure thorough quartz tube cleaning and quartz tube protection. Wiper cycle shall be user selectable and adjustable within a range of 15 minutes to 24 hours depending on anticipated application and deposit build-up. At a minimum the Automatic Wiper System shall have the following characteristics:

• System shall utilize direct Belt Drive with square machined pulleys and shafts to prvent slippage and pin shearing. Systems utilizing shear pins or complicated gear boxes will be unacceptable.
• Wiper power supply shall be 24 volt DC for improved safety.
• System shall incorporate Direct Shaft Encoding for positional location. Systems relying on external proxy switches or internally located magnets will be unacceptable.
• Wiper interval shall be operator selectable with optional override switch.
• Wiper faults are to be indicated on the control system display.
• Wiper System to utilize “Intelligent Operation” for automatic start-up commissioning.
- Records wiper position @ chamber ends. Position must be fixed and not dependent on a timed interval or component striking end of chamber.
- Establish a travel run without setting limit adjustments to ensure system integrity and longevity.

E. Ultraviolet Control System

System shall be epoxy coated NEMA 12 rated cabinet.
Three levels of operation shall be provided to meet the needs of the operator and Interactive water feature environment: Simple Control – (Start, Stop & Reset), Full Parameter Display, and Customized Operator Configuration. Modes of operation shall be password protected to secure system critical setup functions. Control system shall have clearly identifiable Start, Stop and Reset control buttons (suitable for gloved operation) with Running and Fault LCD indicators.

• Two-line LCD screen shall display a minimum of the following: Ultraviolet dose (derived from flow and intensity inputs), Ultraviolet intensity (as a % and mw/cm²), Lamp Current, Flow

rate (accepts signal from optional flow meter – displayed as gallons per minute), Chamber temperature (displayed as deg. F), Operation hour meter, System spares list ing, Lamp fault, low Ultraviolet & temperature alarm, Ground fault trip, Wiper fault. All alarm functions shall have simple text message display to assist in fault finding.

- Control system shall have a minimum of the following system interface control: Remote operation, Process interrupt features (from valves, flow meters), Low UV dose (configurable to shutdown or alarm only, Flow meter input, Auto-restrike, Half to full power Ultraviolet setting with 24hr/7day settable timer.
- Control system shall have built in data-logging capabilities to record the following infor mation: Ultraviolet intensity required, Ultraviolet intensity measured, Lamp current, Chamber temperature, Flow rate (if flow meter connected), Time and date stamp, All alarms generated.

F. Project Commissioning

Ultraviolet Chamber and Control Panel shall be commissioned by a qualified factory trained technician. During this time period, final electrical and control cabling will be connected from the control cabinet to the Ultraviolet disinfection chamber. Daily operation and simple maintenance instructions shall be provided during this commissioning process. A factory trained representative of the manufacturer shall perform all warranty work. Manufacture to warranty Ultraviolet Chamber and Spectra Control panel for a period of 12 months. Medium pressure Ultraviolet bulbs. shall be warranted for a period of 4000 hours. Intermittently operated bulbs ($\geq$ 1 on/off cycles per day) will be replaced free of charge should failure occur prior to 3000 hours and replacement will be prorated between 3000 and 4000 hours. A detailed warranty sheet shall accompany this document upon request.

5.15 AUTOMATIC WATER LEVEL CONTROL:

Water level control of the balancing tank water levels shall be provided through the functions of the chemical controller. Provide all necessary sensors, wiring, conduit and calibration to provide water level control.

5.16 INTERACTIVE WATER FEATURE CONTROLLER:

The enclosure shall be made from corrosion resistant hot compression molded fiberglass reinforced polyester which do not contain halogens. The enclosure shall be capable of withstanding continuous temperature from -58 degrees F to up to 302 degrees F and shall provide indirect electrical contact protection for equipment and operators. Enclosures shall be UL listed per UL Standard 508 for NEMA 3, 4, 4X, 12 and 13; CSA certified per Standard C22.2-0,0.4, 0.7, 0.6, 94 Type 3, 3R, 4, 4X, 12 and 13.

Programmable logic controller shall be sized according to the number of outputs it is required to control. The programmable logic controller shall be factory programmed with a variety of light sequences designed according to the requirements of the project. It shall have the flexibility to modify the sequences using either a transportable memory cartridge or via the touch pad user interface.

The owner/operator shall be able to set the operational hours of the facility via the touch pad user interface. The 24hr/7day timer can be programmed with up to two time intervals that can be scheduled each day.

The operating system's touch pad user interface shall allow for manual override controls for each connected device, activation device(s), and timer. (i.e. Manual, Off and Automatic modes)

The operating system shall be housed in a corrosion resistant molded fiberglass NEMA 4X rated enclosure. All exposed hardware shall be 304/304L stainless steel and shall include a lockable access door.

The operating system shall have the capacity to receive signals from an activation devices, operating on 24VDC.

The operating system shall contain a 120 VAC primary / 24 VAC secondary transformer with built-in electrostatic shield protection.

The operating system shall have the ability to automatically purge all water lines based on the user selected time and duration (i.e. every day at 5 am). It shall also, be configured to purge all lines after a user defined period of inactivity (i.e. after 4 hours of inactivity).

The operating systems shall have the ability to provide a 24VAC auxiliary signal. This signal can be used to trigger a relay for Pumps, Lights, etc.

The operating system will softly start ramp up and will softly ramp down.

The operating system can activate up to a maximum of three play area.

The sequence time could be changed on site.

All main power electrical connections to the Splashpad Controller are to be performed per local codes.

Product drawings and installation manuals shall be supplied by the manufacturer for ease of installation.

PART 6 - INTERACTIVE WATER FEATURE AND DECK EQUIPMENT:

6.00 VACUUM CLEANING EQUIPMENT

Vacuum pump shall be portable, electric, and 110 volt, Single phase, 155 Square Foot Filter. Vacuum pump shall be complete with a 1.0 horsepower pump, waterproof switch, suction connection with check valve, discharge connection with gate valve, hose bib connection for priming, stainless steel pump cart, internal GFI protections, and 100 feet of power cord.

Supply 24" polymer vacuum head for 2" hose, 2" dia. heavy duty Spiral Lock vacuum hose and 1.5" dia. anodized aluminum 12' handle sections with screwed connection. Vacuums should only be connected to GFI protected outlets specifically provided for the model vacuum specified.

6.01 LEAF SKIMMER AND WALL BRUSH:

Leaf skimmers shall have a head of stainless steel with removable screen, handle of aluminum or fiberglass, sixteen feet in length. Wall brushes shall be 24" long, bristles to be 1½" long of nylon, with handle of aluminum or fiberglass, sixteen feet in length.

6.02 TEST KIT:

Test kit shall have chlorine scales 0.4 to 3.0 ppm and pH range from 6.8 to 8.0. It shall have reagents for determining total alkalinity-acid demand and alkalinity demand. Test kit shall include testing abilities for cyanuric acid.

6.03 SAFETY SIGNS:

Safety signs shall be displayed in applicable areas. Lettering shall be contrasting and the size and color specified on the plans and required by code. See Interactive water feature drawings for required verbiage.

6.04 AQUATIC PLAY FEATURES:

Aquatic play features shall be manufactured, installed, maintained, and operated per ASTM F2376 -08 and ASTM F-2461-09 standards.

Aquatic play features shall be as specified on the plans. Because of precise engineering paramters, flows, head losses are design for the specified fittings, substitutions will not be considered.

GENERAL CLAUSES:

The aquatic play products shall be suitable for installation in municipal and commercial aquatic facilities and public play areas. Products shall be specifically designed for the use by children and adults and follow the ASTM F2461-09 norm. In addition, products shall be manufactured by a company that has at least five (5) years of experience in the design and engineering of children's aquatic play areas.

PRODUCT DELIVERY, STORAGE AND HANDLING

1. All aquatic play products and associated equipment must be properly wrapped and secured in place while in transport to the project site. Care shall be observed during offloading and handling to prevent excessive stress and abrasions.
2. At the site, the play products and associated equipment are to be stored in safe areas, out of the way of traffic and other construction activities, until the actual time of installation. If required, safety barricades or other like precautions must be taken for the protection of public and adjacent property.
3. Protective wrapping on the aquatic play features must be left in place until construction work for the water feature is complete.

COMMISSIONING OF THE INTERACTIVE WATER FEATURE
Upon completion of construction, the general contractor shall provide the owner/operator adequate training on facility operations and maintenance. The contractor may request that the equipment manufacturer and/or manufacturer's representative provide on-site start-up and training for the owner/operator.

6.05 EXECUTION:

The manufacturer shall furnish the purchaser with at least two sets of complete installation and operating manuals. The installation manual will illustrate the installation of the entire system. It shall describe the start-up procedure and day- to- day operation of the system.

PART 7 - FINAL PROVISIONS:

7.01 RECORD DRAWINGS, ADDITIONAL TRAINING, OPERATION AND MAINTENANCE MANUALS, AND INSTRUCTIONS:

Upon final acceptance of interactive water feature and related equipment, the following shall be furnished to the Owner:

One set of complete, as built drawings, showing exact location of all piping and of all equipment actually furnished and placed noting any deviations from the contract drawings and specifications, so that the original drawings may be revised.

Five complete sets of printed, indexed instructions, bound in a durable cover, for operation and maintenance of all equipment specified herein and shown on the drawings. These instructions shall also include precise directions for:

a. Maintenance and operation of each component of the filtration system equipment and water feature systems equipment
b. Maintenance and operation of the chemical control system, including complete chemical treatment, water balance
c. Design circulation rates listed of the circulation filtration system.
d. Precise directions for draining and/or winterizing of all circulation equipment and interactive water feature equipment and components (including water features).

7.02 GUARANTEES AND WARRANTIES:

Construction: The successful bidder shall guarantee the interactive water feature structure and finishes against leaking, cracking, failures, and overall water-tightness to the Owner for the period of one (1) year from the date of final completion. The successful bidder shall guarantee the, fittings and equipment to the Owner for the period of one year, or per the equipment manufacturer's warranty, whichever is greater.

A 24 hour response time is required for servicing warranty items. In the event that the interactive water feature contractor fails to provide the required service within 24 hours, the interactive water feature contractor is liable for any cost the owner incurs if the owner chooses to provide the service (assuming the interactive water feature contractor's 24 hour response time has lapsed). If parts are needed from out of state, they shall be air freight delivered. Failure to respond within 24 hours may result in owner providing service from another source and the interactive water feature contractor back charged.

7.03 OWNER TO BE TRAINED BY INSTALLING CONTRACTOR:

The water feature contractor shall provide adequate training of the Owner's representative on the operation, use, and maintenance of all systems and all equipment, including the backwash protocol to landscaping.

The Owner's representative shall be a Certified Pool Operator (CPO).

Training shall occur during normal work-day hours (e.g. from 8:00 a.m. 5:00 p.m.) and on normal workday(s) (e.g. Monday through Friday). The owner's representative shall make himself or herself available to be trained during any normal times and days when the trainer (installing contractor) requests-- with advance notice--to schedule the training.

7.04 ANIMATION PANEL SIMULATION AND COMMISSIONING:

The Critical Phase Observations:

Fountain equipment manufacturer shall also provide two (2) on-site critical phase observations during the construction of the fountain. Contractor shall provide a minimum twelve (12) working days notification before attendance to site.

In-House Choreography and Base Programming

Fountain equipment manufacturer shall provide WATERlab™ physics-based simulation software programs of the fountain (or approved equal). These programs will be issued to the owner group and the aquatic designer for approval well prior to on-site aesthetic commissioning period.

Aesthetic Commissioning

Fountain equipment manufacturer shall provide aesthetic commissioning services to work with the control panel programmer to achieve the desired programs as approved by the owners group and the aquatic designer.

Animation Control Panel Programming and Training

The fountain-equipment manufacturer shall provide adequate on-site programming services to program the fountain to the satisfaction of the owner's group, landscape architect, and aquatic designer.

The fountain-equipment manufacturer shall provide adequate training for owner's staff on the equipment that they have supplied and programmed.

7.05 TRAINING PERIOD:

The successful interactive water feature contractor shall provide the Owner a training period not to exceed 30 days to acquaint the operators in the use and operations of all the various systems and interactive water feature related components (interactive water feature equipment / components, circulation systems, water feature systems). The interactive water feature contractor shall also provide the operators with instruction on draining and /or winterizing all equipment and interactive water feature components. Training session days shall be on a day(s) that falls Monday through Friday from 8:00 A.M. 5:00 P.M.

7.05 OPERATING PERIOD:

The successful interactive water feature contractor shall provide the Owner with a year of operation after the date of turnover. This includes all functions required of the health code and maintaining the water feature in compliance with health standards. Provide chemicals, parts, and operating repairs as needed. Does not include unexpected damage or repairs.

END OF SECTION 131213

SECTION 22 02 00 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings is deemed necessary by the Contractor, details of such departure and the reasons therefore shall be submitted to the Architect/Engineer for approval as soon as reasonably practicable. No such departures shall be made without the prior written approval of the Architect/Engineer.

C. Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such reference shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the judgment of the Architect/Engineer, expressed in writing, is equal to that specified.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of their various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The Contractor shall review all pertinent Drawings, including those of other contracts, prior to commencement of Work.

B. This Division requires the furnishing and installing of all items as specified herein, indicated on the Drawings, or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to: materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Plumbing and Fire Protection items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details with regards to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building/job-site, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

E. All discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to bidding. Where this cannot be done at least seven (7) working days prior to bid; the greater or more

costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified elsewhere, or necessary for complete and functioning plumbing systems shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. The Contractor shall participate in the Commissioning process as required; including, but not necessarily limited to: meeting attendance, completion of checklists, and participation in functional testing.

1.3 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the reviewed Shop Drawings.

B. All piping, fixture, or equipment locations as indicated on the documents do not indicate every transition, offset, or exact location. All transitions, offsets, clearances and exact locations shall be established by actual field measurements, coordination with the structural, architectural and reflected ceiling plans, and other trades. Submit Shop Drawings for review.

C. All transitions, offsets and relocations as required by actual field conditions shall be performed by the Contractor at no additional cost to the owner.

D. Additional coordination with Electrical Subcontractor may be required to allow adequate clearances of electrical equipment, fixtures, and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts, or equipment locations.

1.4 SITE VISIT AND FAMILIARIZATION

A. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the piping, fixtures and equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

B. Understand the existing utilities from which services will be supplied; verify locations of utility services, and determine requirements for connections.

C. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.5 WORK SPECIFIED IN OTHER SECTIONS

A. Finish painting is specified. Prime and protective painting is included in the work of this Division.

B. Owner and General Contractor furnished equipment shall be properly connected to plumbing systems.

C. Furnishing and installing all required plumbing equipment, control relays and electrical interlock devices, conduit, wire and junction boxes are included in the Work of this Division.

1.6 PERMITS, TESTS, INSPECTIONS

A. Arrange and pay for all permits, fees, tests, and all inspections as required by governmental authorities.

1.7 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of Owner occupancy, or the date all punch list items have been completed, or the date final payment has been received. Refer to Division 01 for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the Architect, Owner and Contractor.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such times as the project is ready to receive the equipment, pipe or valves - properly protected from incidental damage and weather damage.

C. Damaged equipment, valves or pipe shall be promptly removed from the site and new, undamaged equipment, valves and pipe shall be provided in its place promptly with no additional charge to the Owner.

1.9 NOISE AND VIBRATION

A. The plumbing systems and the component parts thereof shall be guaranteed to operate without objectionable noise and vibration.

B. Provide foundations, supports and isolators as specified or indicated, properly adjusted to prevent transmission of vibration to the building structure, piping and other items.

C. Carefully fabricate pipe and fittings with smooth interior finish to prevent turbulence and generation or regeneration of noise.

D. All equipment shall be selected to operate with minimum of noise and vibration. If, in the opinion of the Architect/Engineer, objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping or other parts of the Work, the Contractor shall rectify such conditions without extra cost to the Owner.

1.10 APPLICABLE CODES

A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.

B. Arrange with the serving utility companies for the connection, relocation, and upgrade of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.

C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements of the following nationally accepted codes and standards, including, but not necessarily limited to:

1. American Standards Association, ASA.
2. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., ASHRAE.
3. American Society of Mechanical Engineers, ASME.
4. American Society of Plumbing Engineers, ASPE.
5. American Society of Testing Materials, ASTM.
6. American Water Works Association, AWWA.
7. National Bureau of Standards, NBS.
8. National Fire Protection Association, NFPA.
9. UL, LLC (formerly Underwriters Laboratories).
10. FM Global.
11. International Energy Conservation Code, IECC.
12. International Fire Code.
13. International Gas Code.

D. Where differences exist between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the Architect/Engineer in writing of all differences.

E. When directed in writing by the Architect/Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards. Correct the deficiencies and complete the work at no additional cost to the Owner.

1.11 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 01.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the

purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver new to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its Subcontractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification

requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 2009 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.12 DRAWINGS AND SPECIFICATIONS

A. These Specifications are intended to supplement the Drawings. It will not be the province of the Specifications to mention any part of the work which the Drawings are competent to fully explain in every particular and such omission shall not to relieve the Contractor from carrying out portions indicated on the Drawings only.

B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated and the matter referred to the Architect or Engineer for review with a request for information and clarification at least seven (7) working days prior to bid opening date for issuance of an addendum.

C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is equal to the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturers' standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.

D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.

E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equal capacity, construction, and performance. However, under no circumstances shall any substitution by made without the written permission of the Architect or Engineer and Owner. **Request for prior approval must be made in writing at least ten (10) days prior to the bid date without fail.**

F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.

G. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equal construction from the specified list of manufacturers may be substituted, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.

H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUAL" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUAL" product, material or method may be used if it complies with the specifications and is submitted for review to the Engineer as outline herein.

I. Where permission to use substituted or alternative equipment on the project is granted by the Owner or Engineer in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical and Plumbing Design Documents and all other trades, including Division 26.

J. Changes in architectural, structural, electrical, mechanical, and plumbing requirements for the substitution shall be the responsibility of the bidder wishing to make the substitution. This shall include the cost of redesign by the affected designer(s). Any additional cost incurred by affected Subcontractors shall be the responsibility of this bidder and not the Owner.

K. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.

L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with above and if accepted, will issue a written acceptance allowing the substitutions.

M. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the substituting Contractor to coordinate space requirements, building provisions and connection requirements with his trades and all other trades and pay all additional costs to other trades, the Owner, the Architect or Engineer, if any, due to the substitutions.

1.13 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of Shop Drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty (30) day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive Shop Drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all Shop Drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.
2. An index page with a listing of all data included in the Submittal.

3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.
6. Identification of each item of material or equipment matching that indicated on the Drawings.
7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.
8. Additional information as required in other Sections of this Division.
9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 00 and Division 01 for additional information on Shop Drawings and submittals.

C. Equipment and materials submittals and Shop Drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of Shop Drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where Shop Drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop Drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.
2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The Contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.
3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not

approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or Drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.

4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous Shop Drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.
5. CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all Shop Drawings.
6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without Shop Drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Submittals are required for, but not necessarily limited to, the following items:

1. Basic Materials.
2. Plumbing Fixtures and Valves.
3. Supports and Carriers.
4. Floor Drains, Roof Drains, and Cleanouts.
5. Interceptors/Traps (All Types).
6. Water Heaters and Boilers.
7. Expansion Tanks.
8. Water Softeners.
9. Water Treatment Equipment.
10. Water Filters.
11. Domestic Water Booster Pumps.
12. Fire Pumps and Jockey Pumps.
13. Storm, Sanitary, and Wastewater Pumps and Ejectors.
14. Fire Pump and Jockey Pump Controllers.
15. Domestic Water and Fire Protection Break Tanks.
16. Backflow Preventers.
17. Plumbing Piping.
18. Piping, Vessel, and Equipment Insulation.
19. Air Compressors and Air Dryers.
20. Expansion Fittings and Devices.

21. Variable Frequency Drives.
22. Noise and Vibration Controls.
23. Pipe and Equipment Hangers and Supports.
24. Plumbing Specialties.
25. Test, Adjust and Balance Reports.
26. Testing, Adjusting and Balancing Contractor Qualifications.
27. Coordination Drawings.

I. Refer to other Division 22 sections for additional Shop Drawing and submittal requirements. Provide samples of actual materials and/or equipment to be used on the Project upon request of the Owner or Engineer.

1.14 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements of Division 00 and Division 01, in addition to the requirements specified in Division 22.

B. The Contractor shall maintain a separate set of clearly and legibly marked Record Drawings on the job site to record all changes and modifications, including, but not limited to the following: work details, alterations to meet site conditions, and changes made by "Change Order" notices. Mark the drawings with colored pencil(s). These shall be available for review by the Owner, Architect or Engineer during the entire construction stage.

C. The Record Drawings shall be updated concurrently as construction progresses, and in no case less frequently than a daily basis. They shall indicate accurate dimensions for all buried or concealed work; precise locations of all concealed pipe; locations of all valves, controls and operable devices; and any deviations from the work shown on the Construction Documents. All dimensions shall include at least two dimensions to permanent structure points.

D. Record Drawings shall indicate, at a minimum, the following installed conditions:

1. Mains and branches of piping systems, with valves and control devices located and numbered, unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion fittings, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
4. Contract Modifications, actual equipment and materials installed.

E. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

F. If the Contractor does not keep an accurate set of Record Documents, the pay request may be altered or delayed at the request of the Architect. Delivery of Record Documents is a condition of final acceptance. Record Drawings shall be furnished in addition to Shop Drawings.

G. Upon completion of the Work, the Contractor shall submit three (3) full size sets of Record Drawing prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The drawings shall have the name(s) and

seal(s) of the Engineer(s) removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY:_____
(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY:_____
(SIGNATURE)

1.15 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and scheduled dates for each test. This detailed completion and test schedule shall be submittal at least ninety (90) days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit four (4) copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in other Sections of Division 22.

1.16 OPERATIONS AND MAINTENANCE MANUALS

A. Prepare Operations and Maintenance manuals in accordance with the requirements of Division 01 and Division 22. In addition to the requirements of other Sections, this shall include the following information for fixtures, specialties, and equipment items:

1. Identifying names, name tags designations and locations for all equipment.
2. Valve tag lists with valve number, type, color coding, location and function.
3. Reviewed Shop Drawing submittals with exceptions noted compliance letter.
4. Fabrication drawings.
5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

8. Servicing instructions and lubrication charts and schedules.
9. Equipment and motor name plate data.
10. Wiring diagrams.
11. Exploded parts views and parts lists for all equipment and devices.
12. Color coding charts for all painted equipment and conduit.
13. Location and listing of all spare parts and special keys and tools furnished to the Owner.
14. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

B. Coordinate with Division 01 for Operations and Maintenance manual requirements. Unless noted otherwise, bind together in “D ring” style three-ring binders (National model no. 79-883 or equivalent). Binders shall be large enough to allow ¼” of spare capacity. Include three (3) sets with all approved Shop Drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections with tabbed insertable dividers, labeled for easy reference. Utilize the individual specification section numbers shown in the Plumbing Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 22 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

C. In addition to the bound “hard-copy” Operation and Maintenance manuals referenced above, provide an identical electronic copy in searchable PDF format, with all sections bookmarked within the file for easy reference. Provide a USB flash drive with the final manual to the Owner.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer for review a minimum of fourteen (14) working days prior to the beginning of the operator training period.

E. **Operating and Maintenance Manuals which the Engineer deems incomplete, poorly organized, or otherwise unacceptable will be rejected in writing**. The Contractor will subsequently be required to again turn over Operating and Maintenance Manuals, with all deficiencies corrected, until deemed acceptable by the Engineer.

1.17 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include a minimum of 12 hours of on- site training in three (3) shifts of four (4) hours each.

B. Before proceeding with the instruction of Owner’s Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period, obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he or she has a proper understanding of the operation and maintenance of the systems and then resubmit the signed outlines.

C. Refer to other Sections of Division 22 for additional Operator Training requirements.

1.18 FINAL COMPLETION

A. At the completion of the work, all equipment, operable appurtenances, and systems shall be tested. All faulty equipment and material shall be repaired or replaced. Refer to other Sections of Division 22 for additional requirements.

B. Clean and adjust all fixtures, flushometers, valves and operable devices. Replace faulty or otherwise damaged parts immediately prior to final acceptance.

C. Touch up and/or refinish any scratched equipment and devices immediately prior to final acceptance. This shall be acceptable **only for minor superficial scratches**, the determination of which rests solely on the judgment of the Architect or Engineer.

1.19 CONTRACTOR'S GUARANTEE

A. Use of the Plumbing systems to provide temporary service during the construction period shall not be allowed without written permission from the Owner, and, if granted, shall not be cause for the warranty period to start, except as defined below.

B. Contractor shall guarantee to keep the entire installation in repair and perfect working order for a period of one (1) year after its completion and final acceptance, and shall furnish free of additional cost to the Owner all materials and labor necessary to comply with the above guarantee throughout the year beginning from the date of issue of Substantial Completion, Beneficial Occupancy by the Owner, or the Certificate of Final Payment as agreed upon by all parties.

C. This guarantee shall not include cleaning or changing filters except as required by testing, adjusting and balancing.

D. Refer to other Sections of Division 22 for additional guarantee or warranty requirements.

1.20 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for re-use by Architect/Owner or others on extensions of this project or on any other project. Any such re-use or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data’s creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long-term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any re-use or modifications will be Contractor’s sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.

1. It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The Contract Documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.
2. If the client, Architect/Owner, or developer of the project requires electronic media for "record purposes", then an AutoCAD based compact disc ("CD") will be prepared. The "CD" will be submitted with all title block references intact and will be formatted in a "plot" format to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

E. At the Architect/Owner's request, Engineer will prepare one "CD" of electronic media to assist the Contractor in the preparation of submittals. The Engineer will prepare and submit the "CD" to the Architect/Owner for distribution to the Contractor.

1. The "CD" will be prepared and all title blocks, names and dates will be removed. The "CD" will be prepared in a ".dwg" format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide materials and equipment manufactured by a domestic United States manufacturer and assembled in the United States for all local and Federal Government projects. These materials and equipment shall comply with "Buy American Act."

B. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts and other apparatus where concealed. Access doors shall have concealed hinges and screw driver cam locks unless indicated otherwise.

C. All access panels located in wet areas such as toilet rooms, locker rooms, shower rooms, natatoriums, kitchens, and any other wet areas shall be constructed of stainless steel.

D. Access doors shall be as follows:

1. Plastic Surfaces: Milcor Style K.
2. Ceramic Tile Surfaces: Milcor Style M.
3. Drywall Surfaces: Milcor Style DW.
4. Install panels only in locations approved by the Architect.

2.2 EQUIPMENT PADS

A. Provide four (4) inch high concrete pads for indoor floor mounted equipment. Pads shall conform to the shape of the equipment with a minimum extension of six (6) inches beyond the equipment. Top and sides of pads shall be troweled to a smooth finish, equivalent to the floor. External corners shall be bull-nosed to a 3/4" radius, unless shown otherwise.

B. Provide six (6) inch high concrete pads for all exterior mounted equipment. Pads shall conform to the shape of the equipment with a minimum extension of six (6) inches beyond the equipment. Provide a four (4) foot monolithic extension to the pad in front of

the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.) Top and sides of pads shall be troweled to a smooth finish. External corners shall be bull-nosed to a 3/4" radius, unless shown otherwise.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected via reviewed submittals.

B. Refer to equipment specifications in other Divisions (10, 11, 12, 13, 21, 22, etc.) for additional rough-in requirements as necessary and provide accordingly.

3.2 PLUMBING INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of plumbing and fire systems, materials, and equipment. Comply with the following requirements:

1. Coordinate plumbing and fire protection systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, leave-outs, and other openings in building components during progress of construction to allow for plumbing installations.
4. Coordinate the installation of required supporting devices, sleeves, and pathways to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of plumbing and fire protection systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with architectural action markings on submittal, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, resolve conflicts and submit proposed solution to the Architect for review.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location and label.
11. Install access panels or doors where valves, operable devices, and equipment are concealed behind finished surfaces. Refer to Article 2.1 of this Section and to Architectural documents for specifications and locations.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

13. Provide roof curbs for all roof mounted equipment. Coordinate with roof construction for pitched roof. Provide roof curb to match roof slope. Refer to architectural drawings and details.
14. The equipment to be furnished under this Specification shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the product of the same manufacturer.
15. The architectural and structural features of the building and the space limitations shall be considered in selection of all equipment. No equipment shall be furnished which will not suit the arrangement and space limitations indicated.
16. Lubrication: Prior to start-up, check and properly lubricate all bearings as recommended by the manufacturer.
17. Where the word "Concealed" is used in these Specifications in connection with insulating, painting, piping, valves, etc., it shall be understood to mean hidden from sight as in chases, furred spaces or suspended ceilings. "Exposed" shall be understood to mean the opposite of concealed.
18. Identification of Plumbing Equipment:
    a. Plumbing equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Shop Drawings shall include dimensions and lettering format for approval. Attachments shall be with escutcheon pins, self-tapping screws, or machine screws.
    b. Tags shall be attached to all valves, including control valves, with nonferrous chains. Tags shall be brass and at least 1-1/2 inches in diameter. Nameplate and tag symbols shall correspond to the identification symbols on the Record Drawings.

3.3 CUTTING AND PATCHING

A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of plumbing equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer/Owner's observation of concealed Work, without additional cost to the Owner.
7. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers; refer to the materials and methods required for the surface and building components being patched; Refer to Article 1.11 DEFINITIONS AND SYMBOLS for definition of "Installer."

C. Cut, remove and legally dispose of selected plumbing equipment, components, and materials as indicated, including but not limited to removal of plumbing piping, equipment, plumbing fixtures and trim, and other plumbing items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.4 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER, ARCHITECT AND ENGINEER

A. The Owner will cooperate with the Contractor, however, the following provisions must be observed:

1. A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Subcontractors and the Architect/Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.
2. During the construction of this project, normal facility activities will continue in existing buildings until renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems will have to be maintained in service within the occupied spaces of the existing building.

B. Start-up for major plumbing and fire protection equipment shall be performed by a factory authorized technician. Such equipment shall include, but not necessarily be limited to, the following: domestic water boilers and packaged water heating systems, water softeners, ultra-pure water equipment systems, domestic water booster pumps, fire pumps, and break tank level alarm systems. Refer to other Sections of Divisions 21 and 22 for additional requirements.

END OF SECTION

SECTION 22 07 19 – PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. Scope of the Work shall include the furnishing and complete installation of the equipment covered by this Section, with all auxiliaries, ready for owner's use.

B. Furnish and install piping insulation to:

1. Interior domestic hot water and hot water return piping.
2. Interior domestic cold water piping.
3. Exterior domestic cold water piping.
4. Drain bodies and associated piping.
5. Condensate drainage piping.
6. All pipes subject to freezing conditions shall be insulated.

C. Work specified elsewhere.

1. Painting.
2. Pipe hangers and supports.

D. For insulation purposes, piping is defined as the complete piping system including supplies and returns, pipes, valves, automatic control valve bodies, fittings, flanges, strainers, thermometer wells, unions, pressure reducing stations, and orifice assemblies.

1.3 WARRANTY

A. Warrant the Work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from either defective or nonconforming materials or workmanship.

B. Defects shall include, but not be limited to, the following:

1. Mildewing.
2. Peeling, cracking, and blistering.
3. Condensation on exterior surfaces.

1.4 SUBMITTALS

A. SHOP DRAWINGS: Indicate size, material, and finish. Show locations and installation procedures. Include details of joints, attachments, and clearances.

B. PRODUCT DATA: Submit schedules, charts, literature, and illustrations to indicate the performance, fabrication procedures, project variations, and accessories.

1.5 DELIVERY AND STORAGE

A. DELIVERY: Deliver undamaged materials in the manufacturer's unopened containers. Containers shall be clearly labeled with the insulation's flame and smoke ratings.

PART 2 - PRODUCTS

2.1 It is the intent of these specifications to secure superior quality workmanship resulting in an absolutely satisfactory installation of insulation from the standpoint of both function and appearance. Particular attention shall be given to valves, fittings, pumps, etc., requiring low temperature insulation to insure full thickness of insulation and proper application of the vapor seal. All flaps of vapor barrier jackets and/or canvas covering must be neatly and securely smoothed and sealed down.

2.2 The type of insulation and its installation shall be in strict accordance with these specifications for each service, and the application technique shall be as recommended by the manufacturer. All insulation types, together with adhesives and finishes shall be submitted and approved prior to installation.

2.3 A sample quantity of each type of insulation and each type application shall be installed and approval secured prior to proceeding with the main body of the work. Condensation caused by improper installation of insulation shall be corrected by Installing Contractor. Any damage caused by condensation shall be made good at no cost to the Owner or Architect/Engineer.

2.4 All insulation shall have composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to insulation) fire and smoke hazard as tested by Procedure ASTM E084, NFPA 255 and UL 723 not exceeding:

Flame Spread 25
Smoke Developed 50

2.5 Accessories, such as adhesives, mastics and cements shall have the same component ratings as listed above.

2.6 All products or their shipping cartons shall have a label affixed, indicating flame and smoke ratings do not exceed the above requirements.

2.7 APPROVED MANUFACTURERS

A. Calcium silicate materials shall be as manufactured by Johns Manville.

B. Glass fiber materials shall be as manufactured by Johns Manville, Owens-Corning, or Knauf and shall have the same thermal properties, density, fire rating, vapor barrier, etc., as the types specified herein, subject to review by the Engineer.

C. Adhesives shall be as manufactured by Childers, Foster, HB Fuller or Armstrong, and shall have the same adhesive properties, fire rating, vapor seal, etc., as the types specified herein, subject to review by the Engineer.

D. Armaflex elastomeric cellular thermal insulation by Armstrong.

E. Phenolic foam insulation shall be as manufactured by Kooltherm Insulation (Koolphen).

F. Metal jacketing and fitting covers shall be as manufactured by Childers or RPR Products, Inc.

2.8 MATERIALS

A. INTERIOR DOMESTIC WATER PIPE: provide fiberglass pipe insulation with all service jackets with self sealing lap joint.

B. EXTERIOR DOMESTIC WATER PIPE: Provide elastomeric cellular thermal, or preformed phenolic foam pipe insulation with secured aluminum jacketing.

C. DRAIN BODIES AND DOWNSPOUTS: Insulate underside of roof and overflow drain bodies, associated horizontal piping, including first turn down to vertical conductor. Insulate chilled water waste lines from drinking fountain to junction with main waste stacks. Insulate branch lines including traps and exposed underside of floor drains receiving cooling coil condensate, same as water piping where exposed to building occupant view. When concealed, insulation may be same as specified for external duct wrap.

D. CONDENSATE DRAINAGE PIPING: Fire resistant fiberglass insulation; insulation not required when piping is exposed on roof.

E. ALUMINUM OR STAINLESS STEEL JACKETING: Utilize strap-on type jacketing, banding, and accessories. Provide pre-formed fitting covers for all elbows and tees.

PART 3 - EXECUTION

3.1 All insulation shall be installed in accordance with the manufacturers' recommendations and printed installation instructions, including high density inserts at all hangers and pipe supports to prevent compression of insulation.

3.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturers requirements.

3.3 Pipes located outdoors or in tunnels shall be insulated same as concealed piping; and in addition shall have a jacket of 0.016 inch thick, smooth aluminum with longitudinal modified Pittsburg Z-Lock seam and 2 inch overlap. Jacketing shall be easily removed and replaced without damage. All butt joints shall be sealed with gray silicone. Galvanized banding is not acceptable.

3.4 All insulated piping located over driveways shall have an aluminum shield permanently banded over insulation to protect it from damage from car antennas.

3.5 WATER PIPE INSULATION INSTALLATION

A. The insulation shall be applied to clean, dry pipes with all joints firmly butted together. Where piping is interrupted by fittings, flanges, valves or hangers and at intervals not to exceed 25 feet on straight runs, an isolating seal shall be formed between the vapor barrier jacket and the bare pipe. The seal shall be by the applications of adhesive to the exposed insulation joint faces, carried continuously down to and along 4 inches of pipe and up to and along 2 inches of jacket.

B. Pipe fittings and valves shall be insulated with pre-molded or shop fabricated glass fiber covers finished with two brush coats of vapor barrier mastic reinforced with glass fabric.

C. All under lap surfaces shall be clean and free of dust, etc. before the SSL is sealed. These laps shall be firmly rubbed to insure a positive seal. A brush coat of vapor retarder shall be applied to all edges of the vapor barrier jacket.

D. At hangers and supports, provide a high density foam insulation insert that extends 2" beyond the shield on each side and a protective shield/saddle to prevent compression/damage. Secure shield/saddle to insulation using mastic. Also reference specific requirements in Section 22 05 29, Part 3 Execution.

3.6 FIRE RATED INSULATION

A. All pipe penetrations through walls and concrete floors shall be fire rated by applying USG Thermafiber in the space between the concrete and the pipe.

B. The fire rating shall be additionally sealed by using 3M brand model CP 25 or 303 fire barrier caulk and putty.

C. All fire rating material shall be insulated in accordance with manufacturer's printed instructions.

PART 4 - SCHEDULES

4.1 LOW TEMPERATURE SURFACES		MINIMUM INSULATION THICKNESS BASED ON FIBERGLASS
A.	Exposed exterior domestic water pipe:	1½ inch
B.	Interior domestic cold water pipe:	1 inch
C.	Condensate drain lines:	¾ inch
D.	Drains receiving condensate:	1 inch
E.	Concealed piping from roof drains:	1½ inch blanket wrap
F.	Exposed piping from roof drains:	1 inch thick rigid with all service jacket

4.2 HIGH TEMPERATURE SURFACES		MINIMUM INSULATION THICKNESS
A.	Domestic Hot Water and Domestic Hot Water Return Piping	
1.	Pipe sizes 1-1/4 inch and smaller with Operating temperatures of 140°F or less	1 inch
2.	Pipe sizes 1-1/2 inch and larger with Operating temperatures of 140°F or less	1-1/2 inch
3.	Pipe sizes 1-1/4 inch and smaller with Operating temperatures greater than 140°F	1-1/2 inch
4.	Pipe sizes 1-1/2 inch and larger with Operating temperatures greater than 140°F	2 inch

END OF SECTION

SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the piping covered by this Section, with all appurtenances, ready for the Owner's use.

B. Include the following work in addition to items normally part of this Section:

1. Pipe and pipe fittings:

a. Sanitary drainage piping system.

b. Storm drainage piping system.

c. Domestic water piping system.

2. Adapters, Transitions, Unions, Couplings, Flanges, Connectors

3. Valves

4. Excavation, Bedding, and Backfill

1.3 RELATED WORK

A. Section 22 05 29 – Hangers and Support for Plumbing Piping and Equipment.

B. Section 22 05 48 – Vibration and Seismic Controls for Plumbing Piping.

C. Section 22 05 53 – Identification for Plumbing Piping and Equipment.

D. Section 22 07 19 – Plumbing Piping Insulation.

E. Section 22 11 19 – Plumbing Specialties.

F. Section 22 30 00 – Plumbing Equipment.

G. Section 22 40 00 – Plumbing Fixtures.

1.4 REFERENCES

A. ASME – Boiler and Pressure Vessel Code.

B. ASME Section IX – Welding and Brazing Qualifications.

C. ASME B1.20.1 – Pipe Threads, General Purpose.

D. ASME B16.1 – Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

E. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.

F. ASME B16.4 – Gray Iron Threaded Fittings: Classes 125 and 250.

G. ASME B16.5 – Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

H. ASME B16.9 – Factory-Made Wrought Buttwelding Fittings

I. ASME B16.14 – Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads.

J. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

K. ASME B16.23 – Cast Copper Alloy Solder Joint Drainage Fittings: DWV.

L. ASME B16.51 – Copper and Copper Alloy Press-Connect Pressure Fittings.

M. ASME B31.3 – Process Piping.

N. ASME B31.9 – Building Services Piping.

O. ASTM A47 – Standard Specification for Ferritic Malleable Iron Castings.

P. ASTM A53 – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

Q. ASTM A74 – Standard Specification for Cast Iron Soil Pipe and Fittings.

R. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

S. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

T. ASTM A197 – Standard Specification for Cupola Malleable Iron.

U. ASTM A312 – Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes

V. ASTM A395 – Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.

W. ASTM A403 – Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings

X. ASTM A536 – Standard Specification for Ductile Iron Castings.

Y. ASTM A582 – Standard Specification for Free-Machining Stainless Steel Bars.

Z. ASTM B32 – Standard Specification for Solder Metal.

AA. ASTM B42 – Standard Specification for Seamless Copper Pipe, Standard Sizes.

BB. ASTM B43 – Standard Specification for Seamless Red Brass Pipe, Standard Sizes.

CC. ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings.

DD. ASTM B75 – Standard Specification for Seamless Copper Tube.

EE. ASTM B88 – Standard Specification for Seamless Copper Water Tube.

FF. ASTM B148 – Standard Specification for Aluminum-Bronze Sand Castings.

GG. ASTM B306 – Standard Specification for Copper Drainage Tube (DWV).

HH. ASTM B584 – Standard Specification for Copper Alloy Sand Castings for General Applications.

II. ASTM B828 – Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.

JJ. ASTM C33/C33M – Standard Specification for Concrete Aggregates.

KK. ASTM C94 – Standard Specification for Ready-Mix Concrete.

LL. ASTM C150 – Standard Specification for Portland Cement.

MM. ASTM C564 – Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

NN. ASTM C1053 – Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications.

OO. ASTM C1173 – Standard Specification for Flexible Transition Couplings for Underground Piping Systems.

PP. ASTM C1277 – Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.

QQ. ASTM C1540 – Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.

RR. ASTM D635 – Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

SS. ASTM D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

TT. ASTM D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.

UU. ASTM D2241 – Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

VV. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.

WW. ASTM D2464 – Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

XX. ASTM D2466 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

YY. ASTM D2467 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.

ZZ. ASTM D2564 – Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

AAA. ASTM D2665 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

BBB. ASTM D2672 – Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.

CCC. ASTM D2729 – Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

DDD. ASTM D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping.

EEE. ASTM D2843 – Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.

FFF. ASTM D2846 – Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot and Cold Water Distribution Systems.

GGG. ASTM D2855 – Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.

HHH. ASTM D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

III. ASTM D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

JJJ. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.

KKK. ASTM D3311 – Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns.

LLL. ASTM D4976 – Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.

MMM. ASTM D5926 – Standard Specification for Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems.

NNN. ASTM D6707 – Standard Specification for Circular-Knit Geotextile for Use in Subsurface Drainage Applications.

OOO. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

PPP. ASTM F439 – Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.

QQQ. ASTM F441 – Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.

RRR. ASTM F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

SSS. ASTM F493 – Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

TTT. ASTM F656 – Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

UUU. ASTM F913 – Standard Specification for Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

VVV. ASTM F1336 – Standard Specification for Poly (Vinyl Chloride) (PVC) Gasketed Sewer Fittings.

WWW. ASTM F1476 – Standard Specification for Performance of Gasketed Mechanical Couplings for Use in Piping Applications.

XXX. ASTM F1548 – Standard Specification for Performance of Fittings for Use with Gasketed Mechanical Couplings Used in Piping Applications.

YYY. AWS A5.8 – Specification for Filler Metals for Brazing and Braze Welding.

ZZZ. AWS 5.31 – Specification for Fluxes for Brazing and Braze Welding.

AAAA. AWWA C105 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

BBBB. AWWA C111 – Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings.

CCCC. AWWA C209 – Standard for Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.

DDDD. AWWA C219 – Bolted, Sleeve-Type Couplings for Plain-End Pipe.

EEEE. AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service.

FFFF. AWWA C515 – Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Services.

GGGG. AWWA C651 – Disinfecting Water Mains.

HHHH. CISPI 301 – Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

IIII. CISPI 310 – Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

JJJJ. ASSE 1003 Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems.

KKKK. ASSE 1079 – Performance Requirements for Dielectric Pipe Unions.

LLLL. UL 94 Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

MMMM. UL 1285 Standard for Safety Pipe and Couplings, PVC and PVCO for Underground Fire Service.

NNNN. NSF/ANSI 61 – Drinking Water System Components – Health Effects.

OOOO. NSF/ANSI 372 – Drinking Water System Components – Lead Content.

PPPP. Federal Specifications and Standards DD-G-541B – Glass (Laboratory).

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

B. Valves: Manufacturer's name, size, and pressure rating shall be cast or marked on valve body or handle.

C. Piping shall be labeled along its entire length indicating size, class, material specification, manufacturer's name and **country of origin**.

D. Foreign pipe, fittings or valves are unacceptable.

E. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and shall be listed by NSF International.

F. Welding Materials and Procedures: Conform to ASME Code and applicable state labor regulations.

G. Welders Certification: In accordance with ASME Section IX.

1.6 SUBMITTALS

A. Submit under provisions of Division One.

B. Submit product data and video inspection report under provisions of Division One.

C. Include pipe materials, pipe fittings, valves, and accessories. Provide manufacturer's catalog information, product certifications, and **country of origin**. Indicate valve data and ratings.

1.7 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Record actual locations of valves.

C. Include written report and digital video record of waste piping inspection.

1.8 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with a minimum of 5 years documented experience and must be a domestic manufacturer.

B. Installer: Company specializing in performing the work of this section with a minimum of 5 years documented experience.

1.10 DELIVERY, STORAGE, AND HANDLING

A. DELIVERY: Deliver clearly labeled piping and valves to; and store, protect and handle products on site in accordance with the provisions of Division One.

B. TIMING AND COORDINATION: Arrange for delivery of materials to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.

C. ACCEPTANCE: Accept product on site in original factory packaging. Receive valves on site in shipping containers with labeling in place. Inspect for damage. Damaged valves shall not be acceptable.

D. STORAGE: Store materials in a clean, dry location, protected from weather and damage.

E. Provide temporary protective coating on cast iron and steel valves.

F. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

G. Protect installed piping systems from entry of foreign materials by providing temporary covers, as completing sections of the work, and isolating parts of completed systems. Tape will not be allowed as an acceptable end cover.

1.11 EXTRA MATERIALS

A. Furnish under provisions of Division One.

1.12 REGULATORY REQUIREMENTS

A. Perform work in accordance with plumbing and building codes having jurisdiction.

B. **No PVC pipe or fittings, or similar un-rated material, will be allowed in any areas where pipe is to penetrate a fire rated assembly or is to be installed in a return air plenum unless the entire length of all such piping is encased within a minimum two (2) hour fire rated enclosure**.

C. Provide a water pressure regulating valve assembly at the service entry where incoming water supply pressure is greater than 70 psi.

PART 2 - PRODUCTS

2.1 SANITARY SOIL, WASTE AND VENT PIPING, BURIED WITHIN 5 FEET OF BUILDING, BELOW GRADE

A. PVC Pipe: ASTM D1785/D2665 schedule 40 solid wall; installed per ASTM D2321.

1. Fittings: PVC, ASTM D3311/D2665 drainage pattern, with bell and spigot ends. Furnished by the same manufacturer as pipe or approved equal.
2. Joints: solvent weld with ASTM D2564 solvent cement, clear, medium bodied, for sizes 3" and smaller and gray, heavy bodied, for sizes 4" and larger. Mating surfaces shall be prepared with ASTM F656 purple primer immediately prior to cement application.

2.4 SANITARY SOIL, WASTE AND VENT PIPING, WITHIN BUILDING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74 service weight.

1. Fittings: Cast iron, ASTM A74 drainage pattern.
2. Joints: Hub and spigot, ASTM C564 neoprene, compression type gaskets or lead and oakum.
3. Acceptable manufacturers (all pipe and fittings shall be from a single manufacturer):
   a. Tyler Pipe
   b. Charlotte Pipe
   c. AB&I Foundry

B. Copper Tubing: ASTM B306, DWV, for sizes 2" and smaller.

1. Fittings: ASME B16.23 cast copper alloy solder joint drainage fittings (DWV), or ASME B16.29, wrought copper and wrought copper alloy solder joint drainage fittings (DWV).
2. Joints between copper pipe and fittings shall be made in accordance with ASTM B828 using ASTM B32 Alloy Grade Sn 50 solder (50-50 tin-lead).
3. Joints between copper and cast iron pipe shall be made by way of copper soldered to a brass ferrule and the ferrule joined to the cast iron hub by a compression or caulked joint.

C. Brass Pipe: ASTM B43, chrome plated

1. Fittings: ASME B16.23 cast bronze, chrome plated.
2. Joints: In accordance with ASTM B828 using ASTM B32 Alloy Grade Sn 50 solder (50-50 tin-lead) or as recommended by the manufacturer.
3. Applies to exposed piping applications (such as kitchens), wherever required by the prevailing code or by the Authority Having Jurisdiction.

D. Galvanized Steel Pipe: ASTM A53, schedule 40.

1. Fittings: ASME B16.3, ASTM A153 hot-dip galvanized, ASTM A197 malleable iron, minimum pressure class 150.
2. Joints: Threaded joints in accordance with the manufacturer’s installation instructions and ASME B1.20.1. Thread sealant tape or compound shall be applied only on male threads and shall be approved, insoluble in water, and non-toxic.
3. Applies only to limited installations such as services from submersible pumps and ejectors.

2.5 STORM DRAINAGE PIPING, BURIED WITHIN 5 FEET OF BUILDING, BELOW GRADE

A. Pipe and fittings shall be same as specified for sanitary soil, waste and vent piping system.

2.6 STORM DRAINAGE PIPING, WITHIN BUILDING, ABOVE GRADE

A. Cast Iron Pipe: ASTM A74 service weight.

1. Fittings: Cast iron, ASTM A74 drainage pattern.
2. Joints: Hub and spigot, ASTM C564 neoprene, compression type gaskets or lead and oakum.
3. Acceptable manufacturers (all pipe and fittings shall be from a single manufacturer):
   a. Tyler Pipe
   b. Charlotte Pipe
   c. AB&I Foundry

2.7 DOMESTIC WATER PIPE, BURIED WITHIN 5 FEET OF BUILDING EDGE, BELOW GRADE

A. Copper Tubing: ASTM B88, Type K, soft annealed. Provide for pipe sizes up to and including 2-1/2".

1. Fittings: ASTM B16.22 wrought copper pressure fittings.
2. Joints shall be as follows:
   a. **No joints shall be permitted for pipe sizes 2" and smaller. All such piping must be run continuous below slab on grade and brought up to no less than 12" above the finished floor before any joint is provided.**
   b. For sizes larger than 2", joints between copper pipe and fittings shall be brazed and shall be made in accordance with all the applicable portions of ASTM B828, manufacturer's recommendations, and AWS requirements. Brazing filler metal shall be in accordance with AWS A5.8 and any required flux shall meet AWS A5.31, Type FB3-A or FB3-C.
3. Beginning at no closer than the 5'-0" mark from the building, all piping buried or in contact with concrete shall be provided with one of the following, which shall also extend to a minimum of 6" above the finished floor:
   a. AWWA C209 cold-applied, integrated primer type, elastomeric adhesive, laminate polymeric tape coating, minimum 35 mil nominal thickness, in accordance with manufacturer's installation guidelines. Chase Construction Products Tapecoat H35 or approved equivalent.
   b. Continuous polyethylene lining, minimum 60 mil nominal thickness.

B. Ductile Iron Pipe: Minimum pressure class 150, ANSI/AWWA C151/A21.51. Provide for pipe sizes 3" and larger.

1. Fittings: Standard ductile iron, ANSI/AWWA C110/A21.10.
2. Joints: Rubber-gasketed and bolted mechanical joints, ANSI/AWWA C111/A21.11. Installation shall be in accordance with ANSI/AWWA C600 and approved pipe lubricant shall be used for optimum gasket sealing and long-term performance.
3. Note: A single fitting may be installed below slab on grade to facilitate underground pipe entry up to above floor from an immediately adjacent exterior building wall.
4. Provide continuous polyethylene encasement for all piping buried or in contact with concrete in accordance with ANSI/AWWA C105/A21.5, beginning at no closer than the 5'-0" mark from the building and to a minimum of 6" above the finished floor.

C. Stainless Steel Pre-Fabricated In-Building Riser (acceptable for sizes 2" through 10")

1. Corrosion resistant Type 304 stainless steel construction single, extended 90 degree fitting.
2. UL listed, FM approved and NFPA 24 compliant.

3. Lead free and NSF/ANSI 61 (372) certified.
4. Acceptable manufacturers:
   a. Ames Fire & Waterworks Series IBR (4” through 10”) and IBR2 (2”, 2-1/2”, and 3”)
   b. Zurn Wilkins Model WBR (4” through 10”)
5. Note: For this application, the inlet joint for larger diameter (4” through 10”) piping (which **shall not** be located below a building slab or foundation) can be rubber gasketed push-on type, ANSI/AWWA C111/A21.11. Installation shall be in accordance with ANSI/AWWA C600.
6. Provide continuous polyethylene encasement for all piping buried or in contact with concrete in accordance with ANSI/AWWA C105/A21.5, beginning at no closer than the 5’-0” mark from the building and to a minimum of 6” above the finished floor.

2.8 DOMESTIC WATER PIPING, WITHIN BUILDING, BELOW GRADE

A. Copper Tubing: ASTM B88, Type K, soft annealed.

1. No joints allowed below slab, run tubing continuous.
2. Provide AWWA C209 cold-applied, integrated primer type, elastomeric adhesive, laminate polymeric tape coating, minimum 35 mil nominal thickness, in accordance with manufacturer’s installation guidelines, for all piping buried or in contact with concrete, to a minimum of 6" above finished floor. Chase Construction Products Tapecoat H35 or approved equivalent.
3. Applies to installations including services to island sinks and trap primer lines.

2.9 DOMESTIC WATER PIPING, WITHIN BUILDING, ABOVE GRADE

A. Copper Tubing: ASTM B88, Type L, hard drawn.

1. Fittings: ASME B16.18, cast bronze or ASTM B16.22 wrought copper alloy solder joint pressure fittings.
2. Joints between copper pipe and fittings shall be made in accordance with ASTM B828 using ASTM B32 Alloy HB lead-free solder.

B. Stainless Steel Pipe: ASTM A312, schedule 10S, welded or seamless pipe, Type 304/L.

1. Fittings: ASTM A403, wrought stainless steel butt-welding fittings of same Type and wall thickness as piping. Manufactured to the dimensional requirements of ASME B16.9. Chemical composition of the filler metal shall comply with AWS A5.9 based on the alloy content of the piping.
2. Alternatively, rolled grooving with grooved NSF approved stainless steel fittings of the same Type and wall thickness as the piping, complete with the couplings and gaskets of a single approved system manufacturer may be provided throughout.
   a. Such mechanical joints shall comply with ASTM F1476 and ASTM F1548.
   b. Acceptable system manufacturers: Victaulic, Grinnell, Anvil Gruvlok.
3. Joints between pipe and fittings and transition joints to other materials shall be made in accordance with the manufacturer’s installation instructions and using fittings, etc. designed for the specific transition.
4. All pipe, fittings, and installation shall be compliant with NFPA 20, NSF 372, and shall be in accordance with the requirements of NSF 61.

2.10 ADAPTERS, TRANSITIONS, UNIONS, COUPLINGS, FLANGES, CONNECTORS

A. (Non-Acid Waste) Drainage Applications:

1. Provide approved listed adapter and transition fittings appropriate to the specific pipe transition and in accordance with code requirements.
2. For dissimilar piping above ground, provide stainless steel shielded, molded elastomeric couplings and adapters meeting ASTM C564 and ASTM C1460. Applies to installations including cast iron to PVC transitions immediately adjacent to building slabs on grade.
3. For dissimilar underground piping not below building slab, provide shear resistant .012" thick 300 series stainless steel shielded, PVC gasketed flexible couplings and adapters meeting ASTM D5926 and ASTM C1173. For direct-bury applications, provide AWWA C209 cold-applied, integrated primer type, elastomeric adhesive, laminate polymeric tape coating, minimum 35 mil nominal thickness, in accordance with manufacturer's installation guidelines, to completely wrap the shield, banding, and screws. Chase Construction Products Tapecoat H35 or approved equivalent.
4. Acceptable manufacturers:
    a. Anaco-Husky/Cremco
    b. Mission Rubber Company LLC
    a. Fernco, Inc.
    b. Fernco, Inc. Strong Back RC 1000 Series (underground piping, not below building slab; or readily accessible underground piping transitions in backwater valve pits, etc.)
5. Adapters, couplings, bushings for copper DWV pipe shall be cast bronze or wrought copper, ASME B16.23/B16.29.

B. Domestic Water Applications:

1. Provide joints between various materials with approved adapter and transition fittings appropriate to the specific pipe transition and in accordance with code requirements and the manufacturer's instructions.
2. For copper tube and pipe: adapters, bushings, plugs, caps, and couplings shall be wrought copper or cast bronze; flanges (minimum class 150) and unions shall be cast bronze. Provide with solder or threaded connections as necessary and as produced to applicable ASME standards B16.15, B16.18, B16.22, B16.24, B16.50, B1.20.1. All such appurtenances shall be for use in above ground potable water systems.
3. Above slab transitions for water service entries:
    a. 100% fusion bonded epoxy coated ASTM A536 cast ductile iron construction coupling with acrylonitrile butadiene rubber (NBR) gaskets and EPDM insulating boot for water service. 5/8 inch high strength stainless steel bolts and nuts. Coupling shall meet AWWA C219. Romac Industries, Inc. IC501 or pre-approved equivalent.
    b. 100% fusion bonded 14 mil epoxy coated coupling with ASTM A536 cast ductile iron rings. Complete with acrylonitrile butadiene rubber (NBR) gaskets and type 304 stainless steel bridge, spacers, nuts, and bolts. Coupling shall meet AWWA C219, NSF 61, and NSF 372. Krausz USA Hymax Grip Coupling Restraint or pre-approved equivalent.
4. Dielectric connections:
    a. For pipe sizes 2 inch and smaller, provide lead-free dielectric unions, rated to 180 F at 250 psi and compliant to ASSE 1079.
    b. For pipe sizes larger than 2 inches, provide lead-free dielectric flanged pipe fittings, rated to 180 F at 175 psi and meeting ASME B16.1.
    c. For grooved copper joining systems, provide grooved end dielectric transition fitting from system manufacturer, with virgin polypropylene internal lining, meeting NSF 61.

C. General:

1. Unions for ferrous pipe shall be ASTM B16.39 galvanized malleable iron, threaded, minimum pressure class 150.
2. Plugs and bushings for ferrous pipe shall be ASME B16.14 galvanized malleable iron, threaded.
3. Nipples for ferrous pipe shall be schedule 40, galvanized, ASTM A53 welded steel pipe nipples, threaded, meeting ASTM A733.
4. Couplings for ferrous pipe shall be galvanized steel, threaded, manufactured in accordance with ASTM A865.
5. Flanges for ferrous pipe shall be galvanized forged steel construction, either socket weld or slip-on weld type, minimum pressure class 150, manufactured to ASME B16.5.
6. Bolts, nuts, and gaskets for flanged connections shall be appropriate to the pipe material, fluid type, temperature, and pressure. 1/16" thick pre-formed neoprene, typical.
7. Provide flexible stainless steel connectors at pumps and other such equipment, in accordance with manufacturer's recommendations. Connectors shall have corrugated hose and braided 300 series stainless steel jacketing. Carbon steel flanged or grooved ends as appropriate. NSF 372 lead-free for all potable water applications. Metraflex Company or pre-approved equivalent.

2.11 GATE VALVES (IRON)

A. ASTM A126 cast iron bodied, class 125 gate valve with bolted bonnet, non-rising ASTM B16 brass stem and packing gland, solid wedge, cast iron hand-wheel. Bronze wedge for sizes up through 6" and cast iron wedge with bronze bushing and wedge face rings for sizes 8" and larger.

B. Basis of design:

1. NIBCO T-619 (threaded) for sizes 2" through 4".
2. NIBCO F-619 (flanged) for sizes 6" and larger.

C. Acceptable alternate manufacturers:

1. Apollo
2. Milwaukee

D. Applies to only to limited installations such as services from submersible pumps and ejectors. Not to be used for domestic water systems.

2.12 GATE VALVES (DUCTILE IRON)

A. Fusion bonded epoxy coated ASTM A536 ductile iron bodied, class 125 gate valve with bolted bonnet, non-rising Type 304 stainless steel stem, resilient wedge. End connections as suited for adjacent piping. Provide with square operating nut for extended handle operation or with hand-wheel as appropriate for depth of burial and access. Certified lead-free to NSF 61/NSF 372 and AWWA C509 & C515 compliant (3" and larger).

B. Basis of design:

1. NIBCO 619 series for sizes 2" through 12".

C. Applies to outdoor, buried below grade domestic water main installations beyond 5 feet from the building edge. Not to be used inside of buildings.

2.13 BALL VALVES

A. All bronze cast construction two-piece 600 psi body, blow-out proof stem, Teflon seated, lead-free, with stainless steel trim (including ball, stem, and valve handle). Threaded connections. Certified lead-free to NSF 61/NSF 372 and suited to 180 degrees F.

B. Basis of design (bronze valves):

1. NIBCO T-585-66-LF (full port) for all sizes up through 2".
2. NIBCO T-580-66-LF (conventional port) for sizes 2-1/2" and 3".

C. Valves 4" and larger shall be split body stainless steel construction, 275 psi cold working pressure, blow-out proof stem, PTFE seated, type 316 stainless steel trimmed, class 150, full port design with manual gear operator. NIBCO F-515-S6-F-66-FS.

D. Acceptable alternate manufacturers:

1. Apollo 77 CLF-A series (full port) for all sizes up through 2".
2. Milwaukee UPBA-400S (full port) for all sizes up through 2".
3. Apollo 77 CLF-A series (full port) for size 2-1/2" and Apollo 70LF-140 series (standard port) for 3".
4. Milwaukee UPBA-100S (standard port) for sizes 2-1/2" and 3".

E. Applies to domestic water system installations.

F. Provide valves complete with extended lever handles as required to accommodate insulation and full valve operation.

G. Provide valves complete with memory stop kit where used for balancing applications.

2.14 CHECK VALVES (BRONZE)

A. ASTM B62/ASTM B584 bronze body and disc, minimum 200 psi (cold working pressure) Y-pattern horizontal swing type check valve with removable bronze bonnet, Type 300 series stainless steel nuts and hinge pin, and PTFE disc seat. Threaded connections. Certified lead-free to NSF 61/NSF 372 and suited to 180 degrees F.

B. ASTM A126 cast iron bodied, (minimum) class 125 globe style spring loaded (silent) check valve with ASTM B584 bronze disc and seat. Flanged connections. Certified lead-free to NSF 61/NSF 372 and suited to 200 degrees F.

C. Basis of design:

1. NIBCO T-413-Y-LF (Y-pattern swing type) for sizes up through 2".
2. NIBCO F-910-B-LF (globe style spring loaded type) for sizes 2-1/2" and larger.

D. Acceptable alternate manufacturers:

1. Apollo (for sizes up through 2")

E. Applies to domestic water system installations including associated pump discharge lines. Valves shall be suited for installation in both horizontal lines and vertical lines with upward flow, in accordance with manufacturer's recommendations.

2.15 CHECK VALVES (IRON)

A. ASTM A126 cast iron bodied, (minimum) class 125 conventional horizontal swing type check valve with bronze, cast or ductile iron disc. 200 psi cold working pressure. Threaded or flanged connections.

B. Basis of design:

a. NIBCO T-918-B (threaded connections) for sizes 2” through 4”.
b. NIBCO F-918-B (flanged connections) for sizes 6” and larger.

C. Acceptable alternate manufacturers:

a. Apollo (flanged in all sizes)
b. Milwaukee F-2974A (flanged in all sizes)

D. Applies only to limited installations such as services from submersible pumps and ejectors. Not to be used for domestic water systems.

2.16 PRESSURE REGULATING VALVES (PRV’s)

A. ASTM B62/ASTM B584 bronze bodied direct acting, ASSE 1003 single diaphragm type pressure regulating valve with removable bronze bonnet, in-line stainless steel strainer and spring, and FDA approved EPDM seat disc and Buna-N diaphragm. Threaded connections. Certified lead-free to NSF 61/NSF 372 and suited to 180 degrees F.

B. NSF 61 epoxy coated ductile iron bodied pilot-operated globe style pressure regulating valve assembly. Complete with low-flow bypass and stainless steel, bronze, and copper trim and fittings. NSF 61 EPDM seat disc and diaphragm. Threaded or flanged connections. Suited to 180 degrees F.

C. Basis of design:

1. Apollo PRH-LF (36HLF series) for direct acting valves, sizes up through 3”. Provide with y-strainer. Provide threaded up through 2” and flanged for larger sizes.
2. Apollo A127-LF series for pilot operated valves, sizes 1-1/4” through 4”.

D. Acceptable alternate manufacturers:

1. Cla-Val
2. Victaulic (pilot-operated valves)

E. PRV’s shall automatically reduce inlet pressure to a steady lower downstream pressure, regardless of changing flow rate. Provide complete with inlet strainer, inlet and outlet pressure gauges, isolation valves, and unions. Provide bypass line around assembly with normally closed valve.

2.17 BALANCING VALVES

A. Self-contained, fully automatic thermally actuated balancing valve shall continuously adjust flow to maintain the desired domestic hot water temperature within the branch line, regardless of system operating pressure. Valve shall modulate between open and closed position within a 10 degrees F range. Valve body and all internal components shall be constructed of stainless steel with major components constructed of Type 303 stainless. Rated for 200 psi maximum working pressure and no less than 250 degrees F maximum working temperature. Lead-free and ANSI/NSF 61 compliant. Threaded connections.

B. Basis of design:

1. ThermOmegaTech Circuit Solver, sizes 1/2" through 2”. Provide a union and ball type shutoff valve on both sides of the balancing valve.
2. ThermOmegaTech Circuit Solver with integrated union (CSU) assembly, sizes 1/2" and 3/4". Balancing valve assembly shall come complete with union body and ball type shutoff valves on both sides.

C. Applies to circulated domestic hot water system installations including multi-branch parallel piping circuits and single-loop piping circuits.

1. Provide balancing valve at end of **each** domestic hot water supply line (after last fixture served) just prior to the hot water return line, as indicated on Drawings and in accordance with manufacturer’s installation recommendations.
2. Provide a pipe tee or elbow with bushing as appropriate, 3/4" threaded thermowell, and bi-metal adjustable angle 3 inch dial thermometer upstream of each balancing valve. Thermowell stem length and thermometer temperature probe length to be suited for pipe size, insulation thickness, and to ensure clearance for maintenance access and easy viewing of thermometer. Trerice bimetal/sensor, threaded-stepped shank thermowell (style 76) of lead-free brass (PBF) material. Trerice Model B836 thermometer with 300 stainless steel case and stem, hermetically sealed, double strength glass windowed, aluminum white-faced dial, complete with external reset and 0 to 200 degrees F range. Thermowell and thermometer face to be oriented upright for readability.

PART 3 - EXECUTION

3.1 EXCAVATION, BEDDING AND BACKFILL

A. This section shall apply for the excavation, bedding, and backfill of all buried piping unless specifically noted otherwise. All work shall be coordinated with any job site subsurface drainage/dewatering and adjusted accordingly.

B. Establish elevations of buried piping outside the building to ensure the following:

1. Not less than 2 feet of cover, or not less than maximum depth of frost penetration, whichever is the greater.
2. For water lines intended for fire protection service, the depth of cover shall be:
   a. Not less than 2’-6” in those locations where frost is not a factor.
   b. Not less than 1’-0” below the frost line for the locality.
   c. Not less than 3’-0” for piping under driveways.
   d. Not less than 1’-0” below the bottom of the building foundation/footers.
   e. In full compliance with the requirements of NFPA 13 and NFPA 24.

C. Excavation:

1. Excavate trenches for underground piping to the required depths.
2. The bottom of the trench or excavation shall be cut to a uniform grade.
3. Should rock be encountered, excavate 6 inches below grade, fill with bedding material and tamp to existing density.
4. Coordinate alignment of pipe trenches to avoid obstructions. Ensure that proposed routing of pipe will not interfere with building foundation before any trenching has begun. Should conflicts occur, contact Architect/Engineer before proceeding.
5. Should any sleeving of the building foundation be required, this shall be provided as directed by the structural engineer of record AND in accordance with the

prevailing code, but in no case shall the sleeve be any less than two (2) pipe sizes greater than the pipe it serves.

D. Bedding and Backfill:

1. Backfill shall not be placed until the piping has been inspected, tested and approved. Complete backfill to the surface of natural ground or to the lines and grades indicated on drawings. **Provide 6 inch stabilized sand bed with 4 inch stabilized sand cover around each pipe**. Provide select fill up to finished surface or grade, unless indicated otherwise by project geotechnical report or specified otherwise in Division 02.
2. Compacting Backfill: Place material in uniform layers of 8 inches maximum, loose measure and compact to not less than 95% of maximum soil density as determined by ASTM D-698 Standard Proctor.
3. Restoration: Compact backfill, where trenching or excavation is required in improved areas such as pavements, walks and similar areas, to a condition equal to the adjacent undisturbed earth and restore surface of the area to the condition existing prior to trenching or excavating operation.
4. A clay fill “trench plug” extending 3 feet inside the building line and 5 feet outside the building line shall be placed to completely surround utility lines passing beneath the foundation and grade beam. The materials shall consist of on-site soils with a plasticity index (PI) between 30 and 40 percent compacted to at least 95 percent of the Standard Proctor and maximum dry density as determined by ASTM D-698.

E. Cement Stabilized Sand:

1. Materials:
   a. Cement shall be Type I Portland cement conforming to ASTM C150.
   b. Sand shall be clean, durable sand meeting grading requirements for fine aggregates of ASTM C33 and free of organic matter and deleterious substances.
   c. Water shall be potable and free of oils, acids, alkalis, organic matter, or other deleterious substances, meeting requirements of ASTM C94.
2. Mixture:
   a. Product shall consist of not less than 1.5 sacks of Portland cement per ton of dry sand.
   b. Mixture shall contain sufficient water to hydrate the cement and be thoroughly mixed in a pugmill type mixer.

F. For water lines (including In-Building Risers) intended for fire protection service, provide joint restraints by way of concrete thrust blocks in accordance with the requirements of NFPA 13 and NFPA 24.

G. Aggressive Soil Conditions: Soil shall be considered aggressive and protection of buried metallic piping shall be provided as specified if any of the following situations exist:

1. Conditions are identified as such by the project geotechnical report or project geotechnical engineer.
2. The soil environment is a landfill area, swamp, marsh, polluted river bottom, cinder bed, or has alkaline soils.
3. A score of ten or higher is tallied when applying the soil assessment tool detailed in Appendix A of AWWA C105. An excerpt of this evaluation procedure is provided below for reference but is not intended as a substitute for the complete and latest Standard:

Numerical Corrosivity Scale

Soil Parameter	Assigned Points
Resistivity (ohm-cm)	
<700	10
700 – 1,000	8
1,000 – 1,200	5
1,200 – 1,500	2
1,500 – 2,000	1
>2,000	0
pH	
0 – 2	5
2 – 4	3
4 – 6.5	0
6.5 – 7.5	0
7.5 – 8.5	0
>8.5	3
Redox Potential (mV)	
>100	0
50 – 100	3.5
0 – 50	4
<0	5
Sulfides	
Positive	3.5
Trace	2
Negative	0
Moisture	
Poor drainage continuously wet	2
Fair drainage generally moist	1
Good drainage generally dry	0

3.2 INSTALLATION

A. General requirements for piping:

1. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
2. Remove any scale, oil and dirt, on inside and outside, before assembly.
3. Prepare piping connections to equipment with flanges or unions.
4. Confirm pipe placement, depth/elevation, and flow lines prior to any installation.

B. General requirements for valves:

1. Install valves with stems upright or horizontal, not inverted.
2. Valves shall be line-sized unless specifically noted otherwise.
3. Provide clearance for installation of insulation and access to valves and operable fittings. Valves installed beyond reasonable reach shall be provided with a chain operator.

4. Provide access doors where valves and operable fittings are not otherwise accessible. Access doors shall be of approved types set in locations pre-approved by submittal to the Architect.
5. Gate valves installed below grade shall be covered with an adjustable cast iron roadway box extended to grade. Cover shall be cast iron with 'water' cast on top of cover and shall be set flush to finished paving or 2" above finished earthen grade. Box shall be supported from undisturbed soil or concrete base and shall not introduce any stress to piping under all traffic conditions.

C. Install all materials in accordance with the manufacturer's published instructions.

D. All exposed sewer and water pipe in toilet rooms or other finished areas of the building shall be chrome plated.

E. Provide non-conducting dielectric connections wherever joining dissimilar metals.

F. Route piping in an orderly manner, parallel and perpendicular to building column grid lines, unless indicated otherwise on drawings, and maintain gradients.

G. Install piping to conserve building space and not conflict with other trades or interfere with intended use of space.

H. Group piping whenever practical at common elevations.

I. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Provide encasement for and support for utility meters in accordance with the requirements of utility companies.

L. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting.

M. Maintain uniformity in the installation of piping materials and joining methods. Do not mix material types.

N. Where connecting new underground sanitary, storm, or vent piping to existing piping of dissimilar material, provide suitable mechanical transition fittings complete with corrosion protection for metallic elements. Chase Construction Products Tapecoat H35 or approved equivalent and a final coat of coal tar to completely cover the transition.

O. Solder joints shall be wiped clean at each joint, remove excess metal while molten and flux residue when cooled.

P. Waste nipple from wall to tapped tee shall be schedule 40 threaded galvanized steel pipe or brass or copper with threaded adapter.

Q. General requirements for cast iron piping installation:

1. Install all pipe and fittings in accordance with published recommendations from the manufacturer and the Cast Iron Soil Pipe Institute (CISPI). Specific items referenced below are not intended as a substitute for the complete and latest recommendations.
2. Install bell and spigot type pipe with bell end upstream.

3. Above ground horizontal pipe (suspended) shall:
   a. Be supported at no less than at every joint, and within 18” of the hub or coupling.
   b. Be maintained in alignment. Sagging or grade reversal shall be unacceptable.
   c. Be supported at terminal ends of all runs or branches and at each change of direction or alignment.
   d. Have all closet bends, traps, trap arms, and similar branches firmly secured.
   e. Be braced to prevent movement or joint separation.
   f. Be provided with suitable sway bracing (such as clamps, rods, and hardware) where pipe and fittings are suspended in excess of 18” by means of non-rigid hangers.
4. Above ground vertical pipe shall:
   a. Be secured at each stack base.
   b. Be secured at each floor and riser clamps shall be provided on no greater than 15’-0” intervals.
   c. Be adequately supported to keep the system (pipe and contents) in alignment.
5. Provide seismic restraints in seismically active areas, whether specifically required by the prevailing code or not.

R. All grooved system tools and components (couplings, adapters, fittings, gaskets, **valves**, and specialties) shall be the product of a single domestic system manufacturer.

S. Grooved pipe system manufacturer shall provide on-site training for contractor’s field personnel by a factory trained representative in the proper use of grooving tools, application of groove, and product installation. Factory trained representative shall periodically visit the job site and inspect installation. Contractor shall remove and replace any improperly installed products at no additional cost to the owner.

3.3 APPLICATION

A. Provide union downstream of all valves at equipment or apparatus connections.

B. Provide male adapters each side of threaded valves in copper piped system. Sweat solder adapters to tube prior to make-up of threaded connections.

C. Provide approved isolation valves for shut-off and to isolate all equipment items and distinct parts of systems. Isolation valves shall be provided for both hot and cold water in locations including, but not necessarily limited to, the following:

1. At each floor for each domestic water tap branching off from a vertical riser.
2. At each domestic water branch line capped for future use.
3. At each restroom or restroom group.
4. At each hose bibb, wall hydrant, hose reel, and trap primer device (except for flush valve or tailpiece type trap primer devices).
5. At each domestic water branch line within 24” of the corresponding main.
6. At each plumbing fixture not otherwise served by a localized fixture group isolation valve.

D. Each plumbing water rough-in stub out shall be fitted with a supply stop.

E. Valves installed in insulated piping shall be fitted with extended lever operators of sufficient length to raise handle above the insulation jacket material. Where valve is used for throttling service, the valve handle shall be equipped with adjustable memory stop device.

F. Provide non-slam type check valves on discharge lines from all water pumps. Install at a minimum length of 5 times the pipe diameter from the pump and in accordance with manufacturer's installation recommendations.

3.4 ERECTION TOLERANCES

A. All gravity drainage lines in the building shall have 1/4 inch per foot fall where possible and not less than 1/8 inch per foot fall toward the main sewer. Pipe must be laid so that the slope will be uniform and continuous. Permission shall be secured from the Architect and Engineer before proceeding with any Work where existing conditions prevent the installation at the minimum grade specified.

B. All vent and branch vent pipes shall be graded and connected as to drip back by gravity to the drainage pipe it serves. A slope of 1 inch per 40 feet will suffice for this requirement, subject to the approval of the local Authority Having Jurisdiction.

C. Slope all horizontal water piping with uniform pitch of 1/8 inch per 10 feet to low points to allow for complete system drainage. For long runs, where constant pitch cannot be maintained, provide intermediate low points and rise up again from such locations. Slope horizontal branches back to mains or risers. Provide clearly identified supplementary drain valves where hose bibbs, hydrants, or sill cocks will not suffice for this requirement.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, all domestic water systems shall be complete, thoroughly flushed clean and free of all foreign matter or erection residue.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. On building side of the main shut off valve, provide a 3/4" connection through which chlorine can be introduced into the water piping

D. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, in sufficient quantity to obtain 50 to 80 mg/L residual free chlorine solution throughout the entire domestic water piping systems.

E. Bleed water from outlets as required to ensure complete distribution and test for disinfectant residual at a minimum 15 percent of total outlets.

F. Maintain disinfectant in system for 24 hours.

G. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

H. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

I. Take samples no sooner than 24 hours after flushing, from 5 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.6 SERVICE CONNECTIONS

A. Provide new sanitary and storm sewer services connecting to existing building services or utility lines as shown on the drawings.

B. Before commencing work, field verify invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover as required.

C. Provide new domestic water service connecting to existing building services or utility lines as shown on plans. Assure connections are in compliance with requirements of the jurisdiction having authority.

D. Extension of services to the building shall be fabricated from the same materials as the utility service lines or those materials specified herein.

E. Should points of connection vary from those indicated on the drawings contractor shall properly allow for this in the actual connections field fabricated.

3.7 RODDING SEWERS

A. All sanitary soil and waste lines, both in the building and out, shall be rodded out after completion of the installation.

B. This Work shall be done, as part of the contract, to make certain that all lines are clear, and any obstruction that may be discovered shall be removed immediately. Rodding shall be accomplished by utilizing a rotary cutter, which shall be full size of pipe being cleaned.

3.8 VIDEO INSPECTION AND DOCUMENTATION

A. It shall be the responsibility of the plumbing contractor to retain the services of a qualified, independent company (**other than the installing plumbing contractor**) with no less than ten (10) years of experience in digital video camera inspection/investigation of plumbing drainage waste and vent lines for commercial/institutional building projects.

B. The independent company shall perform a complete video camera inspection of all waste piping buried below grade inside the building. This shall include sanitary waste and any specialty waste (grease waste, oily waste, etc.) systems and shall extend from the building all the way to any associated outdoor traps/interceptors.

C. The independent company shall create a permanent digital video record of their inspection with accompanying definitive identification (audio or visual) to indicate different systems and different areas of the systems inspected.

D. The independent company shall prepare a comprehensive written report including, but not necessarily limited to, the following:

1. Complete company contact information.
2. Project name and address.
3. Date(s), time(s), and conditions during the inspection(s).
4. Name(s) of the operator(s) performing the inspection(s).
5. A general summary of the inspection results.
6. A written description of any and all material and/or installation deficiencies or irregularities found, with accompanying pictorial documentation. This shall include conditions such as:
    a. Deformed or damaged piping
    b. Full or partial blockage of piping
    c. Deleterious material or debris within the piping
    d. Slope deficiencies (inadequate, inconsistent, or absent slope)
    e. Valleys or “dips” in the piping

f. Improper fittings in the piping including reductions in pipe size in the direction of flow

E. The written report shall be submitted under this Section but separately from other submittals of this Section. This shall occur immediately prior to substantial completion.

F. The written report and the digital video record (DVD or USB flash drive) shall also be submitted as part of the Project Record Documents.

3.9 TESTING OF PLUMBING PIPING SYSTEMS

A. During the progress of the work and upon completion, tests shall be made as specified herein and as required by Authorities Having Jurisdiction, including Inspectors, Owner or Architect. The Architect or duly authorized Construction Inspector shall be notified in writing at least 2 working days prior to each test or other Specification requirement which requires action on the part of the Construction Inspector.

B. Tests shall be conducted as part of this work and shall include all necessary instruments, equipment, apparatus, and service as required to perform the tests with qualified personnel. Submit proposed test procedures, recording forms, and test equipment for approval prior to the execution of testing.

C. Tests shall be performed before piping of various systems have been covered or furred-in. For insulated piping systems testing shall be accomplished prior to the application of insulation.

D. All piping systems shall be tested and proved absolutely tight for a period of not less than 24 hours. Tests shall be witnessed by the Architect or an authorized representative and pronounced satisfactory before pressure is removed or any water drawn off.

E. Leaks, damage or defects discovered or resulting from test shall be repaired or replaced to a like new condition. Leaking pipe joints, or defective pipe, shall be removed and replaced with acceptable materials. Test shall be repeated after repairs are completed and shall continue until such time as the entire test period expires without the discovery of any leaks.

F. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five 5 days. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period.

G. Domestic Water: Pressure test at one and one half times the normal working pressure or 125 psig, whichever is the greater, for 24 hours.

H. Sanitary Soil, Waste and Vents and Storm Sewer:

1. After the rough-in soil, waste and vent and other parts of the sanitary sewer including branch laterals have been set from the lowest level, at point of connection to existing utility lines, to above the floor line, all outlets shall be temporarily plugged or capped, except as are required for testing as described herein. Ground work shall not permit the backfill of trenches to cover any joints until the completion of testing. Back fill shall be limited to mid sections of full joints of piping only. For pipe in ground the piping shall be readied as described herein and filled with water to a verifiable and visible level to 10' above the lowest portions of the system being tested.

2. On multi-level buildings only one floor level shall be tested at a time. Each floor shall be tested from a level below the structure of the floor, or the outlet of the building in the case of the lowest level, to a level of 12 inches above the floor immediately above the floor being tested, or the top of the highest vent in the case of the highest building level. The pipes for the level being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for 24 hours. If after 24 hours the level of the water has been lowered by leakage, the leaks must be found and stopped, and the water level shall again be raised to the level described, and the test repeated until, after a 24 hour retention period, there shall be no perceptible lowering of the water level in the system being tested.
3. Should the completion of these tests leave any reasonable question or doubt of the integrity of the installation, additional tests including peppermint smoke, or other measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's duly authorized representative. Such tests shall be conducted and completed before any joints in plumbing are concealed or made inaccessible.

3.10 COMPLETE FUNCTIONING OF WORK

A. All work reasonably implied as essential to the complete functioning of the systems shown on the Drawings and Specification shall be completed as part of the work of this Division, unless specifically stated otherwise. It is the intention of the Drawings and Specification to establish the type and function of systems but not to set forth each item essential to the functioning of any system. In case of doubt as to the work intended or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for Supplementary Instructions and Drawings, etc.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. The Basic Materials and Methods, Section 22 02 00, are included as a part of this Section as though written in full in this document.

1.2 SCOPE

A. The scope of the work shall include the furnishing and complete installation of the fixtures covered by this Section, with all appurtenances, ready for the Owner's use.

B. Include the following work in addition to items normally part of this Section:

1. Plumbing Fixtures
2. Fixture Carriers
3. Faucets, Supplies, and Trim
4. Flushometers

1.3 RELATED WORK

A. Section 22 05 29 – Hangers and Support for Plumbing Piping and Equipment

B. Section 22 10 00 – Plumbing Piping

C. Section 22 11 19 – Plumbing Specialties

D. Section 22 30 00 – Plumbing Equipment

1.4 REFERENCES

A. ASME A112.4.3 – Plastic Fittings for Connecting Water Closets to the Sanitary Drainage System

B. ASME A112.6.1M – Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use

C. ASME A112.18.1 – Plumbing Supply Fittings

D. ASME A112.18.2 – Plumbing Waste Fittings

E. ASME A112.18.9 – Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures

F. ASME A112.19.1 – Enameled Cast Iron and Enameled Steel Plumbing Fixtures

G. ASME A112.19.2 – Ceramic Plumbing Fixtures

H. ASME A112.19.3 – Stainless Steel Plumbing Fixtures

I. ASME A112.19.7 – Hydromassage Bathtub Systems

J. NSF/ANSI 61 – Drinking Water System Components – Health Effects

K. ANSI Z358.1 – Emergency Eyewash and Shower Equipment

L. ASSE 1016 – Performance Requirements for Individual Thermostatic, Pressure Balancing, and Combination Pressure Balancing and Thermostatic Control Valves for Individual Fixture Fittings.

M. ASSE 1037 – Performance Requirements for Pressurized Flushing Devices for Plumbing Fixtures

N. ADA (Americans with Disabilities Act)

O. TAS (Texas Accessibility Standards)

1.5 QUALITY ASSURANCE

A. Manufacturer: For each product specified, provide components by the same manufacturer throughout.

B. Warranty: Warrant the work specified herein for one year against becoming unserviceable or causing an objectionable appearance resulting from defective or non-conforming materials and workmanship.

C. Defects shall include, but not necessarily be limited to, the following:

1. Noisy operation.
2. Noticeable deterioration of finish.
3. Leakage of water.

1.6 SUBMITTALS

A. Submit under provisions of Division One.

B. Submit product data under provisions of Division One.

C. Include component sizes, rough-in requirements, service sizes, finishes, materials, dimensions, performance information, and accessories.

D. Manufacturer’s Installation Instructions: Indicate assembly and support requirements.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Provide pre-printed operating and maintenance instructions for each item specified. Instruct and demonstrate the proper operation and maintenance to the Owner's designated representative.

1.8 DELIVERY, STORAGE, AND HANDLING

A. DELIVERY: Deliver clearly labeled specialties to; and store, protect and handle products on site in accordance with the provisions of Division One.

B. TIMING AND COORDINATION: Arrange for delivery of materials to allow for minimum storage time at the project site. Coordinate with the scheduled time of installation.

C. ACCEPTANCE: Accept specialties on site in original factory packaging. Inspect for damage. Damaged specialties shall not be acceptable.

D. STORAGE: Store materials in a clean, dry location, protected from weather and damage.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on the Contract Documents.

B. Confirm and field coordinate that millwork is constructed with adequate provisions for the installation of counter top lavatories and sinks.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. GENERAL: Provide plumbing fixtures in accordance with manufacturer's recommendations and as indicated and scheduled on Drawings. Acceptable manufacturers of each fixture type are as indicated below.

1. Provide floor-affixed fixture carriers as appropriate for all wall-hung plumbing fixtures unless specifically noted otherwise.
2. Fixture drilling shall match faucet spread and match any related trim and accessories.

B. WATER CLOSETS, URINALS, LAVATORIES, COMBINATION UNITS (Stainless Steel, Security Fixtures)

1. Acorn
2. Willoughby

C. EMERGENCY SAFETY FIXTURES

1. Bradley
2. Guardian
3. Chicago
4. Haws
5. Speakman

D. DRINKING FOUNTAINS AND WATER COOLERS

1. Halsey Taylor
2. Elkay
3. Haws
4. Oasis

2.2 FAUCETS, SUPPLIES, AND TRIM

A. GENERAL: Provide faucets, supplies, and trim in accordance with manufacturer's recommendations, as appropriate for fixtures to be served, and as indicated and scheduled

on Drawings. Acceptable manufacturers for each type of appurtenance are as indicated below.

1. Flushometer flush rate shall match gallon-per-flush criteria of fixtures served.
2. Strainers shall be heavy cast brass chrome plated with matching grid type strainer, with or without overflow as required, 17 gauge seamless brass tailpiece of length determined by installation requirements. Provide complete with washers and brass locknut.
3. P-traps shall be 17 gauge seamless chrome plated brass, adjustable type. Provide complete with cleanout plug, chrome plated brass slip nuts, wall bend, and wrought brass escutcheon of depth determined by installation requirements.
4. Angle stops shall be lead-free commercial pattern chrome plated brass, quarter turn ball type with loose key handles. Provide complete with chrome plated copper supply risers and wrought brass escutcheon of depth determined by installation requirements.
5. Toilet seats shall be commercial grade and provided complete with stainless steel posts and self-sustaining check hinges.
6. Pipe trim insulation shall be compliant, white molded vinyl, fade/discoloration-resistant, bacteria/fungal-resistant insulation.

B. FAUCETS

1. Chicago
2. T&S Brass
3. Zurn
4. Moen Commercial
5. Delta Commercial
6. American Standard
7. Kohler
8. Symmons Commercial
9. Sloan

C. FLUSHOMETERS

1. Sloan
2. Zurn
3. Moen Commercial
4. Delta Commercial
5. American Standard
6. Toto

D. SUPPLY STOPS

1. McGuire
2. Zurn
3. Chicago

E. CHROME PLATED TUBULAR BRASS

1. McGuire
2. Zurn
3. Kohler

F. TOILET SEATS

1. Church
2. Bemis

3. American Standard
4. Zurn
5. Toto

G. PIPE TRIM INSULATION

1. Dearborn Safety Series
2. Truebro
3. McGuire
4. Plumberex

2.3 FIXTURE CARRIERS

A. GENERAL: ANSI/ ASME A112.6.1M; Provide floor-affixed fixture carriers as appropriate for all wall-hung plumbing fixtures unless specifically noted otherwise. Fixture carrier foot supports shall be securely anchored to the floor with 1/2” bolts and anchors at all locations.

1. Chair type carriers shall be adjustable, with coated cast iron body with integral no hub waste and vent connections, complete with gasketed adjustable faceplate assembly, adjustable nipple with test cap, neoprene bowl gasket, lugs for floor and wall attachment, threaded fixture studs, and hardware. Provide single or double type of vertical or horizontal configuration as required and with auxiliary inlet as required.
2. Lavatory carriers shall be adjustable, with steel uprights and welded base feet, coated cast iron support brackets, cast or ductile iron concealed support arms, alignment rod, complete with leveling and support hardware. Provide single or back to back configuration as required.
3. Drinking fountain and urinal carriers shall be adjustable, with steel uprights and welded base feet, upper and lower bearing plates, threaded rods, and mounting hardware. Provide single or side-by-side configuration as required

B. ACCEPTABLE MANUFACTURERS

1. J.R. Smith
2. Zurn
3. Mifab
4. Watts
5. Wade
6. Josam

PART 3 – EXECUTION

3.1 PREPARATION

A. EXAMINATION OF CONDITIONS: Examine conditions affecting this work. Report unsatisfactory conditions to the proper authority and do not proceed until those conditions have been corrected. Commencing work implies acceptance of existing conditions as satisfactory to the outcome of this work.

B. Coordinate forming of roof/floor construction to receive drains to required invert elevations.

3.2 INSTALLATION

A. Install fixtures in locations and heights as shown on Drawings and as directed by the Architect.

B. Install materials plumb, level, securely, and in accordance with manufacturer's recommendations.

C. All rough-in pipe openings for final connections with supply, waste, vent, and storm systems shall be closed with caps or plugs during early stages of construction and installation. Tape shall not be considered sufficient protection.

D. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

E. Provide ball valves in piping serving batteries of fixtures. Label stops "Hot" and "Cold." Valves shall be located above accessible ceilings. If ceilings are not accessible, provide access panels of adequate size to ensure valves are fully accessible and can be fully operated.

F. Provide lockable ball valves in piping serving emergency safety fixtures and clearly label such valves as to the fixtures served.

G. Plumbing fixtures shall be supported by a concealed carrier where required to properly support the fixture specified. All carriers to be securely mounted, bolted and checked prior to concealment.

H. Caulk around fixtures with best grade white silicone caulking. Do not use grout.

I. All handles on supply and drainage fittings or other brass items shall be properly lined up and adjusted. Fittings shall not be left in any haphazard manner.

J. All fixtures shall have individual chrome plated heavy pattern loose key quarter-turn cutoff stops on supply lines, complete with escutcheons. Where same are not specified as a part of the fixture trim, they shall be installed as close to fixtures as possible in the hot and cold water supply.

K. Install each fixture with trap, easily removable for servicing and cleaning.

L. All showers and similar installations shall be installed with type “L” copper pipe between shower valve and shower head rough-in. The termination point shall have a brass drop ear elbow for shower head arm connection. Contractor shall provide proper anchoring support.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

B. Review architectural drawings. Confirm configuration and orientation of shower controls and trim prior to rough-in and installation.

3.4 ADJUSTING

A. Adjust work under provisions of Division One.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.5 CLEANING

A. Clean work under provisions of Division One.

B. At completion clean plumbing fixtures and appurtenances.

3.6 PROTECTION OF FINISHED WORK

A. Protect finished Work under provisions of Division One.

B. Do not permit use of fixtures.

3.7 ADA ACCESSIBLE FIXTURES

A. At all locations required to be accessible, such fixtures, controls, and final installations shall comply with the requirements of ADA and any applicable state accessibility standards. Install fixtures to heights, indicated on architectural drawings.

B. All exposed water supply and drain pipes under accessible lavatories and sinks shall be insulated with securely fastened pipe trim insulation kits of the proper model for the fixtures specified.

C. Wall mounted drinking fountains and coolers which protrude into passages or corridor space, whether single or paired with an adjacent accessible fixture, shall be supplied with a matching skirt or apron to lower the underside clearance of the non-accessible fixture equal to that required for accessible fixture.

END OF SECTION

SECTION 23 02 00 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings is deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect/Engineer for review as soon as practicable. No such departures shall be made without the prior written approval of the Architect/Engineer.

C. Notwithstanding any reference in the Specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number, such reference shall not be construed as limiting competition; and the Contractor, in such cases, may at his option use any article, device, product, material, fixture, form or type of construction which in the judgment of the Architect/Engineer, expressed in writing, is the equivalent of that specified.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form complete and functioning systems in all of their various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The Contractor shall review all pertinent drawings, including those of other contracts, prior to commencement of Work.

B. This Division requires the furnishing and installing of all items as specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Mechanical (HVAC) items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

E. All discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to bidding. Where this cannot be done at least 7 working days prior to bid; the greater or more costly of the

discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. The Contractor shall participate in the commissioning process as required; including, but not limited to, meeting attendance, completion of checklists, and participation in functional testing.

1.3 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The Contract Documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the reviewed shop drawings.

B. All duct or pipe or equipment locations as indicated on the documents do not indicate every transition, offset, or exact location. All transitions, offsets, clearances and exact locations shall be established by actual field measurements, coordination with the structural, architectural and reflected ceiling plans, and other trades. Submit shop drawings for review.

C. All transitions, offsets and relocations as required by actual field conditions shall be performed by the Contractor at no additional cost to the Owner.

D. Additional coordination with electrical contractor may be required to allow adequate clearances of electrical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.4 SITE VISIT AND FAMILIARIZATION

A. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

B. Understand the existing utilities from which services will be supplied; verify locations of utility services, and determine requirements for connections.

C. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.5 WORK SPECIFIED IN OTHER SECTIONS

A. Finish painting is specified. Prime and protective painting are included in the work of this Division.

B. Owner and General Contractor furnished equipment shall be properly connected to Mechanical (HVAC) systems.

C. Furnishing and installing all required Mechanical (HVAC) equipment control relays and electrical interlock devices, conduit, wire and J-boxes are included in the Work of this Division.

1.6 PERMITS, TESTS, INSPECTIONS

A. Arrange and pay for all permits, fees, tests, and all inspections as required by governmental authorities.

1.7 DATE OF SUBSTANTIAL COMPLETION

A. The date of final acceptance shall be the date of substantial completion. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the Architect, Owner and Contractor.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct - properly protected from incidental damage and weather damage.

C. Damaged equipment, duct or pipe shall be promptly removed from the site and new, undamaged equipment, pipe or duct shall be installed in its place promptly with no additional charge to the Owner.

1.9 NOISE AND VIBRATION

A. The heating, ventilating and air conditioning systems, and the component parts thereof, shall be guaranteed to operate without objectionable noise and vibration.

B. Provide foundations, supports and isolators as specified or indicated, properly adjusted to prevent transmission of vibration to the building structure, piping and other items.

C. Carefully fabricate ductwork and fittings with smooth interior finish to prevent turbulence and generation or regeneration of noise.

D. All equipment shall be selected to operate with minimum of noise and vibration. If, in the opinion of the Architect, objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of the Work, the Contractor shall rectify such conditions without extra cost to the Owner.

1.10 APPLICABLE CODES AND STANDARDS

A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.

B. Arrange with the serving utility companies for the connection of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.

C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements which includes and is not limited to the following nationally accepted codes and standards:

1. Air Moving & Conditioning Association, AMCA.
2. American Standards Association, ASA.
3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., ASHRAE.
4. American Society of Mechanical Engineers, ASME.
5. American Society of Plumbing Engineers, ASPE.
6. American Society of Testing Materials, ASTM.
7. American Water Works Association, AWWA.
8. National Bureau of Standards, NBS.
9. National Fire Protection Association, NFPA.
10. Sheet Metal & Air Conditioning Contractors' National Association, SMACNA.
11. Underwriters' Laboratories, Inc., UL.
12. International Building Code, IBC.
13. International Energy Conservation Code, IECC.
14. International Fire Code, IFC.
15. International Fuel Gas Code, IFGC.
16. International Mechanical Code, IMC.

D. Where differences existing between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the Engineer in writing of all differences.

E. When directed in writing by the Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, correct the deficiencies, and complete the work at no additional cost to the Owner.

1.11 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 01.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive, but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the

Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor, or its Subcontractor or Sub-subcontractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor or, when so noted, by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances, and implies

words and meanings which will be appropriately interpreted. Actual word abbreviations of a self-explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by the latest ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.12 DRAWINGS AND SPECIFICATIONS

A. These Specifications are intended to supplement the Drawings and it will not be the province of the Specifications to mention any part of the Work which the Drawings are competent to fully explain in every particular and such omission is not to relieve the Contractor from carrying out portions indicated on the Drawings only.

B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated and the matter referred to the Architect or Engineer for review with a request for information and clarification at least 7 working days prior to bid opening date for issuance of an addendum.

C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is the equivalent of the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturer’s standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.

D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.

E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equivalent capacity, construction, and performance. However, under no circumstances shall any substitution be made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing 10 calendar days prior to the bid date without fail.

F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.

G. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equivalent construction from the specified list of manufacturers may be substituted, it is the intention of the Owner or Engineer that

products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.

H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUIVALENT" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUIVALENT" product, material or method may be used if it complies with the Specifications and is submitted for review to the Engineer as outline herein.

I. Where permission to use substituted or alternative equipment on the project is granted by the Owner or Engineer in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical (HVAC) Design Documents and all other trades, including Division 26.

J. Changes in architectural, structural, electrical, mechanical, and plumbing requirements for the substitution shall be the responsibility of the bidder wishing to make the substitution. This shall include the cost of redesign by the affected designer(s). Any additional cost incurred by affected Subcontractors shall be the responsibility of this bidder and not the Owner.

K. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.

L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with the requirements listed above; and if accepted, will issue a letter allowing the substitutions.

M. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the substituting Contractor to coordinate space requirements, building provisions and connection requirements with his trades and all other trades; and to pay all additional costs to other trades, the Owner, the Architect or Engineer, if any, due to the substitutions.

1.13 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty-day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

1. A cover sheet with the names and addresses of the Project, Architect, MEP

Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

2. An index page with a listing of all data included in the Submittal.
3. A list of variations page with a listing of all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.
6. Identification of each item of material or equipment matching that indicated on the Drawings.
7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.
8. Additional information as required in other Sections of this Division.
9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "REVISE AND RESUBMIT".

B. Refer to Division 00 and Division 01 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "REVIEWED", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. REVIEWED: Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.
2. REVIEWED AS NOTED: Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order

the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.

3. NOT APPROVED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not approved. The Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or Drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.
4. REVISE AND RESUBMIT: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit. The Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.
5. CONTRACTOR'S CERTIFICATION REQUIRED: Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating that the submittal meets all conditions of the Contract Documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.
6. MANUFACTURER NOT AS SPECIFIED: Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified. The Contractor will automatically be required to furnish the product, material or method named in the Specifications. Contractor shall not order equipment when submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without submittal review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Submittals are required for, but not limited to, the following items subject to project requirements:

1. Coordination Drawings
2. Common Motor Requirements for HVAC Equipment
3. Expansion Fittings and Loops for HVAC Piping
4. Variable Frequency Motor Speed Control for HVAC Equipment
5. Hangers and Support for Piping and Equipment HVAC
6. Vibration and Seismic Controls for HVAC Piping and Equipment
7. Testing, Adjusting, and Balancing
8. Duct Insulation
9. HVAC Equipment Insulation
10. HVAC Piping Insulation
11. Refrigerant Monitor System
12. Energy Management and Control System
13. Above Ground Hydronic Piping
14. Hydronic Specialties

15. Hydronic Pumps
16. Refrigerant Piping
17. Metal Ductwork
18. Ductwork Accessories
19. HVAC Fans
20. High-Volume Low-Speed Propeller Fans
21. Dust Collection Systems
22. Series Fan Powered Terminal Units
23. Single Duct VAV Terminal Box
24. Parallel Fan Powered Terminal Unit
25. Dual Duct Air Terminal Units
26. Air Distribution Devices
27. Air Filters
28. Flue Pipe Systems
29. Non-Condensing Boiler-Gas Fired (Forced Draft)
30. Condensing Boiler – Gas Fired
31. Finned Water-Tube Boilers
32. Steel Water-Tube Boilers
33. Gas Fired Furnaces
34. Gas Fired Roof Mounted Make-up Air Unit Heaters
35. Shell and Tube Heat Exchanger
36. Plate-Type, Liquid-To-Liquid Heat Exchangers
37. Centrifugal Liquid Chiller
38. Rotary Screw Water Chillers
39. Air Cooled Rotary Liquid Chiller
40. Induced Draft Cooling Tower
41. Energy Recovery Ventilator
42. Modular Indoor Central Station Air Handling Units
43. Packaged Air Handling Unit
44. Modular Outdoor Central Station Air Handling Units
45. 100% Outside Air Rooftop Unit with Gas Heat
46. Self-Contained Air Conditioners
47. Rooftop Heating and Cooling Units Electric Cooling-Gas Heating
48. Rooftop Heating and Cooling Units Electric Cooling-Electric Heat
49. Variable Air Volume Rooftop Units
50. Variable Refrigerant Flow (VRF) for HVAC System
51. Water Source Heat Pump Unit
52. Fan Coil Unit
53. Unit Ventilators
54. Electric Duct Heaters
55. Radiant Heating Electric Cables
56. Air Conditioning Unit for Swimming Pool Enclosures

I. Refer to other Division 23 sections for additional submittal requirements. Provide samples of actual materials and/or equipment to be used on the Project upon request of the Owner or Engineer.

1.14 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access, and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:

    a. Wall and type locations.
    b. Clearances for installing and maintaining insulation.
    c. Locations of light fixtures and sprinkler heads.
    d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
    e. Equipment connections and support details.
    f. Exterior wall and foundation penetrations.
    g. Routing of storm and sanitary sewer piping.
    h. Fire-rated wall and floor penetrations.
    i. Sizes and location of required concrete pads and bases.
    j. Valve stem movement.
    k. Structural floor, wall and roof opening sizes and details.

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting coordination drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DOCUMENTS

A. Prepare Record Documents in accordance with the requirements of Division 00 and Division 01, in addition to the requirements specified in Division 23.

B. The Contractor shall maintain a separate set of clearly and legibly marked Record Drawings on the job site to record all changes and modifications, including, but not limited to the following: work details, alterations to meet site conditions, and changes made by "Change Order" notices. Mark the drawings with colored pencil(s). These shall be available for review by the Owner, Architect or Engineer during the entire construction stage.

C. The Record Drawings shall be updated concurrently as construction progresses, and in no case less frequently than a daily basis. They shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents. All dimensions shall include at least two dimensions to permanent structure points.

D. Record Drawings shall indicate, at a minimum, the following installed conditions:

1. Duct mains and branches, size and location, for both exterior and interior; locations of dampers, fire dampers, duct access panels, and other control devices; filters, fuel fired heaters, fan coils, condensing units, and roof-top A/C units requiring periodic maintenance or repair.
2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
5. Contract Modifications, actual equipment and materials installed.

E. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located as specified herein to record the locations and invert elevations of underground installations.

F. If the Contractor does not keep an accurate set of Record Drawings, the pay request may be altered or delayed at the request of the Architect. Delivery of Record Documents is a condition of final acceptance. Record Drawings shall be furnished in addition to Shop Drawings.

G. The Contractor shall submit an electronic copy of the record documents in PDF format and one (1) full size set of Record Drawing prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The drawings shall have the name(s) and seal(s) of the Engineer(s) removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY:_____
(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY:_____
(SIGNATURE)

1.16 OPERATING AND MAINTENANCE MANUALS

A. Prepare operating and maintenance manuals in accordance with Division 00 and Division 01 and, in addition to the requirements specified in those Divisions, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping,

shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

1.17 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and scheduled date for each test. This detailed completion and test schedule shall be submitted at least 90 days before the projected substantial completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of substantial completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to, those items outlined in Section 23 02 00.

1.18 OPERATING AND MAINTENANCE MANUALS

A. Prepare Operations and Maintenance manuals in accordance with the requirements of Division 01 and Division 23. In addition to the requirements of other Sections, this shall include the following information for equipment items:

1. Identifying names, name tags designations and locations for all equipment.
2. Valve tag lists with valve number, type, color coding, location and function.
3. Reviewed Shop Drawing submittals with exceptions noted compliance letter.
4. Fabrication drawings.
5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
8. Servicing instructions and lubrication charts and schedules.
9. Equipment and motor name plate data.
10. Wiring diagrams.
11. Exploded parts views and parts lists for all equipment and devices.
12. Color coding charts for all painted equipment and conduit.
13. Location and listing of all spare parts and special keys and tools furnished to the Owner.
14. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

B. Coordinate with Division 01 for Operations and Maintenance manual requirements. Unless noted otherwise, bind together in “D ring” style three-ring binders (National model no. 79-883 or equivalent). Binders shall be large enough to allow ¼” of spare capacity. Include three (3) sets with all approved Shop Drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections with tabbed insertable dividers, labeled for easy reference. Utilize the individual specification section numbers shown in the Mechanical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 23 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

C. In addition to the bound “hard-copy” Operation and Maintenance manuals referenced above, provide an identical electronic copy in searchable PDF format, with all sections bookmarked within the file for easy reference. Provide a USB flash drive with the final manual to the Owner.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer for review a minimum of fourteen (14) working days prior to the beginning of the operator training period.

E. Operating and Maintenance Manuals which the Engineer deems incomplete, poorly organized, or otherwise unacceptable will be rejected in writing. The Contractor will subsequently be required to again turn over Operating and Maintenance Manuals, with all deficiencies corrected, until deemed acceptable by the Engineer.

1.19 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include a minimum of 12 hours of onsite training in three (3) shifts of four (4) hours each.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period, obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 23 Sections for additional Operator Training requirements.

1.20 FINAL COMPLETION

A. At the completion of the Work, all equipment and systems shall be tested and faulty equipment and material shall be repaired or replaced. Refer to Sections of Division 23 for additional requirements.

B. Clean and adjust all air distribution devices and replace all air filters immediately prior to Substantial Completion.

C. Touch up and/or refinish all scratched equipment and devices immediately prior to Substantial Completion.

1.21 CONTRACTOR'S GUARANTEE

A. Use of the HVAC systems to provide temporary service during construction period will not be allowed without permission from the Owner in writing; and, if granted, shall not cause the warranty period to start, except as defined below.

B. Contractor shall guarantee to keep the entire installation in repair and perfect working order for a period of one year after the date of the Substantial Completion, and shall furnish (free of additional cost to the Owner) all materials and labor necessary to comply with the above guarantee throughout the year beginning from the date of Substantial Completion, Beneficial Occupancy by the Owner, or the Certificate of Final Payment as agreed upon by all parties.

C. This guarantee shall not include cleaning or changing filters except as required by testing, adjusting and balancing.

D. All air conditioning compressors shall have parts and labor guarantees for a period of not less than 5 years beyond the date of Substantial Completion.

E. Refer to Sections in Division 23 for additional guarantee or warranty requirements.

1.22 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner's risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney's fees arising out of or resulting thereof.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently, or otherwise, without authorization of the data's creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be at the Contractor's sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect's written consent.

1. It is agreed that "MEP" hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The Contract Documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.
2. If the client, Architect or Owner of the project requires electronic media for

"record purposes", then AutoCAD/ Revit documents will be prepared by Engineer on electronic media such as removable memory devices, flash drives or CD's. These documents can also be submitted via file transfer protocols. AutoCAD/ Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

3. At the Architect/Owner's request, Engineer will assist the Contractor in the preparation of the submittals and prepare one copy of AutoCAD/ Revit files on electronic media or submit through file transfer protocols. The electronic media will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a ".rvt" or ".dwg" format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide materials and equipment manufactured by a domestic United States manufacturer and assembled in the United States for all local and Federal Government projects. These materials and equipment shall comply with "Buy American Act."

B. Access Doors: Provide access doors as required for access to equipment, valves, controls, cleanouts and other apparatus where concealed. Access doors shall have concealed hinges and screw driver cam locks.

C. All access doors located in wet areas such as restrooms, locker rooms, shower rooms, kitchen and any other wet areas shall be constructed of stainless steel.

D. Access Doors: shall be as follows:

1. Plaster Surfaces: Milcor Style K.
2. Ceramic Tile Surface: Milcor Style M.
3. Drywall Surfaces: Milcor Style DW.
4. Install doors only in locations approved by the Architect.

2.2 EQUIPMENT PADS (See 2.4 in Section 26 02 00)

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected via reviewed submittals.

B. Refer to equipment specifications in Divisions 2 through 48 for additional rough-in requirements.

3.2 MECHANICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.

3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with architectural action markings on submittal, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, resolve conflicts and submit proposed solution to the Architect for review.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as possible, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location and label.
11. Install access doors where units are concealed behind finished surfaces. Refer to paragraph 2.1 in this section and architect for access doors specifications and location.
12. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
13. Provide roof curbs for all roof mounted equipment. Coordinate with roof construction for pitched roof. Provide roof curbs which match the roof slope and provides a level top for equipment installation. Refer to Architectural drawings and details.
14. The equipment to be furnished under these Specifications shall be essentially the standard product of the manufacturer. Where two or more units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the system need not be the product of the same manufacturer.
15. The Architectural and Structural features of the building and the space limitations shall be considered in selection of all equipment. No equipment shall be furnished which will not suit the arrangement and space limitations indicated.
16. Lubrication: Prior to start-up, check and properly lubricate all bearings as recommended by the manufacturer.
17. Where the word "Concealed" is used in these Specifications in connection with insulating, painting, piping, ducts, etc., it shall be understood to mean hidden from sight as in chases, furred spaces or suspended ceilings. "Exposed" shall be understood to mean the opposite of concealed.
18. Identification of Mechanical Equipment:

    a. Mechanical equipment shall be identified by means of nameplates permanently attached to the equipment. Nameplates shall be engraved laminated plastic or etched metal. Submittals shall include dimensions and lettering format for approval. Attachment shall be with escutcheon pins,

self-tapping screws, or machine screws.

b. Tags shall be attached to all valves, including control valves, with nonferrous chain. Tags shall be brass and at least 1-1/2 inches in diameter. Nameplate and tag symbols shall correspond to the identification symbols on the temperature control submittal and the "as-built" drawings.

19. Provide construction filters for all air handling units, fan coil unit, VAV boxes, and all other air handling equipment during the entire construction period.
20. Provide temporary construction strains for all strainers in the hydronic systems during the initial flushing of the systems.

3.3 CUTTING AND PATCHING

A. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.

B. Perform cutting, fitting, and patching of mechanical equipment and materials required to:

1. Uncover Work to provide for installation of ill-timed Work.
2. Remove and replace defective Work.
3. Remove and replace Work not conforming to requirements of the Contract Documents.
4. Remove samples of installed Work as specified for testing.
5. Install equipment and materials in existing structures.
6. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer/Owner's observation of concealed Work, without additional cost to the Owner.
7. Patch existing finished surfaces and building components using new materials matching existing materials and experienced Installers. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers; refer to the materials and methods required for the surface and building components being patched; Refer to Paragraph 1.11 I for definition of "Installer."

C. Cut, remove and legally dispose of selected mechanical equipment, components, and materials as indicated, including but not limited to removal of mechanical piping, mechanical ducts and HVAC units, and other mechanical items made obsolete by the new Work.

D. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.4 WORK SEQUENCE, TIMING, COORDINATION WITH OWNER, ARCHITECT AND ENGINEER

A. The Owner will cooperate with the Contractor, however, the following provisions must be observed:

1. A meeting will be held at the project site, prior to any construction, between the Owner's Representative, the General Contractor, the Sub-Contractors and the Engineer to discuss Contractor's employee parking space, access, storage of equipment or materials, and use of the Owner's facilities or utilities. The Owner's decisions regarding such matters shall be final.

2. During the construction of this project, normal facility activities will continue in existing buildings until renovated areas are completed. Plumbing, fire protection, lighting, electrical, communications, heating, air conditioning, and ventilation systems shall be maintained in service within the occupied spaces of the existing building.
3. Contractor shall not start-up any of the HVAC equipment unless the Owner, Architect and Engineer are signed off.
4. Start-up for major HVAC equipment such as chillers, cooling towers, variable frequency drives and hot water boilers shall be performed by a factory technician. The start-up shall include a written report signed off by Contractor, Engineer and Owner.

3.5 DEMOLITION AND WORK WITHIN EXISTING BUILDINGS

A. In the preparation of these documents every effort has been made to show the approximate locations of, and connections to, the existing piping, duct, equipment and other apparatus related to this phase of the Work. However, this Contractor shall be responsible for verifying all of the above information. This Contractor shall visit the existing site to inspect the facilities and related areas. This Contractor shall inspect and verify all details and requirements of all the Contract Documents, prior to the submission of a proposal. All discrepancies between the Contract Documents and actual job-site conditions shall be resolved by the contractor, who shall produce drawings that shall be submitted to the Architect/Engineer for review. All labor and materials required to perform the work described shall be a part of this Contract.

B. All equipment and/or systems noted on the Drawings "To Remain" shall be inspected and tested on site to certify its working condition. A written report on the condition of all equipment to remain, including a copy of the test results and recommended remedial actions and costs shall be made by this Contractor to the Architect/Engineer for review.

C. All equipment and/or systems noted on the Drawings "To Be Removed" shall be removed including, associated pipe and duct, pipe and duct hangers and/or line supports. Where duct or pipe is to be capped for future or end of line use, it shall be properly tagged with its function or service appropriately identified. Where existing equipment is to be removed or relocated and has an electric motor or connection, the Electrical Contractor shall disconnect motor or connection, remove wiring to a safe point and this Contractor shall remove or relocate motor or connection along with the equipment.

D. During construction and remodeling, portions of the Project shall remain in service. Construction equipment, material, tools, extension cords, etc., shall be arranged so as to present minimum hazard or interruption to the occupants of the building. None of the construction work shall interfere with the proper operation of the existing facility; or be so conducted as to cause harm or danger to persons on the premises. All fire exits, stairs or corridors required for proper access, circulation or exit shall remain clear of equipment, materials or debris. The General Contractor shall maintain barricades, other separations in corridors and other spaces where work is conducted.

E. Certain work during the demolition and construction phases may require overtime or night time shifts or temporary evacuation of the occupants. Coordinate and schedule all proposed down time with the Owner at least seventy-two (72) hours in advance in writing.

F. Any salvageable equipment as determined by the Owner, shall be delivered to the Owner, and placed in storage at the location of his choice. All other debris shall be removed from the site immediately.

G. Equipment, piping or other potential hazards to the occupants of the building shall not be

left overnight outside of the designated working or construction area.

H. Make every effort to minimize damage to the existing building and the Owner's property. Repair, patch or replace as required any damage that occurs as a result of work at the site. Care shall be taken to minimize interference with the Owner's activities during construction and to keep construction disrupted areas to a minimum. Coordinate with the Owner and other trades in scheduling and performance of the work.

I. Include in the contract price all rerouting of existing pipe, duct, etc., and the reconnecting of the existing equipment as necessitated by field conditions to allow the installation of the new systems regardless of whether or not such rerouting, reconnecting or relocating is shown on the Drawings. Furnish all temporary pipe, duct, controls, etc., as required to maintain heating, cooling, and ventilation services for the existing areas with a minimum of interruption.

J. All existing pipe, duct, materials, equipment, controls and appurtenances not included in the remodel or alteration areas are to remain in place.

K. Pipe, duct, equipment and controls serving mechanical and other Owner's equipment, etc., which is to remain but is served by pipe, duct, equipment and controls that are disturbed by the remodeling work, shall be reconnected in such a manner as to leave this equipment in proper operating condition.

L. No portion of the **fire protection systems** shall be turned off, modified or changed in any way without the express knowledge and written permission of the Owner’s representative in order to protect systems that shall remain in service.

M. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and operating system in cooperation with other trades with a minimum of disruption or downtime.

N. Refer to Architectural Demolition and/or Alteration plans for actual location of walls, ceilings, etc., being removed and/or remodeled.

END OF SECTION

SECTION 23 31 13 - METAL DUCTWORK

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Low pressure ductwork.

B. Casings.

C. Underground buried ducts.

D. Duct leakage testing.

E. Duct system protection.

F. Duct system cleaning.

1.2 RELATED SECTIONS

Division 9 - Finishes: Weld priming, weather resistant, paint or coating.

A. Section 23 02 00 - Basic Material and Methods.

B. Section 23 05 29 – Hangers and Support for Piping and Equipment HVAC.

C. Section 23 05 93 - Testing, Adjusting and Balancing.

D. Section 23 07 13 - Duct Insulation.

E. Section 23 33 00 - Ductwork Accessories.

F. Section 23 37 13 - Air Distribution Devices.

1.3 QUALITY ASSURANCE

A. Manufacturer’s Qualifications: Firms regularly engaged in manufacture of metal ductwork products of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Installer’s Qualifications: Firms with least 3 years of successful installation experience on projects with metal ductwork systems similar to that required for project.

C. Codes and Standards:

1. SMACNA Standards: Comply with latest SMACNA’s “HVAC Duct Construction Standards, Metal and Flexible” for fabrication and installation of metal ductwork.
2. ASHRAE90.1 Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 “Duct Construction”, for fabrication and installation of metal ductwork.
3. NFPA Compliance: Comply with NFPA 90A “Standard for the Installation of Air Conditioning and Ventilating Systems”, NFPA 90B “Standard for the Installation of Warm Air Heating and Air Conditioning Systems”, and NFPA 96 Standard.
4. IECC 2015: Comply with 2015 International Energy Conservation Code.

1.4 GENERAL DESCRIPTION

A. Extent of metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

1.5 SUBMITTALS

A. Submit shop drawings, duct fabrication standards and product data under provisions of Division One.

B. Indicate duct fittings, particulars such as gauges, sizes, welds, and configuration prior to start of work.

C. The contract documents are schematic in nature and are to be used only for design intent. The contractor shall prepare sheet metal shop drawings, fully detailed and drawn to scale, indicating all structural conditions, all plumbing pipe and light fixture coordination, and all offsets and transitions as required to permit the duct to fit in the space allocated and built. All duct revisions required as a result of the contractor not preparing fully detailed shop drawings will be performed at no additional cost.

1.6 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain indicated clear size inside lining. Where offsets or transitions are required, the duct shall be the equivalent size based on constant friction rate.

B. Low Pressure: Low pressure ductwork shall be rated for an operating pressure of 2”. Low pressure ductwork shall be defined as all return, exhaust, and outside air ducts, all supply ductwork associated with constant volume air handling units with a scheduled external static pressure of less than 2”, and all supply ductwork downstream of terminal units in variable volume systems.

C. Medium Pressure: Medium pressure ductwork shall be rated for an operating pressure of 4”. Medium pressure ductwork shall be defined as all supply ductwork extending from variable volume air handling units to terminal units in variable volume systems with air handling units having a scheduled external static pressure of less than 4”. The supply ductwork of constant volume air handling units having a scheduled external static pressure greater than 2” and less than 4” shall be rated for medium pressure.

D. High Pressure: High pressure ductwork shall be rated for an operating pressure of 6”, or the scheduled external pressure of the equipment it is connected to, whichever is greater. The supply ductwork of air handling units having a scheduled external static pressure greater than 4” shall be high pressure.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings, use sheet metal end caps on any lined duct exposed to the weather.

B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

B. Sheet Metal: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A653.

C. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A480; Type 316; with No. 4 finish where exposed to view in occupied spaces, No. 1 finish elsewhere. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.

D. Aluminum Sheet: Where indicated, provide aluminum sheet complying with ASTM B 209, Alloy 3003, Temper H14.

2.2 MISCELLANEOUS DUCTWORK MATERIALS

A. General: Non-combustible and conforming to UL 181, Class 1 air duct materials.

B. Flexible Ducts: Flexmaster U.S.A., Inc. Type 5M, Thermaflex MKE, ATCO #036 or approved equal; corrosive resistant galvanized steel formed and mechanically locked to inner fabric with minimum 1-1/2” thick, R-6 insulation. Flexible duct shall be rated up to at least 10 in.w.g. positive pressure and shall have reinforced metalized outer jacket to comply with UL 181, Class 1 air duct.

C. Sealants: Hard-Cast “iron grip” or approved equal, non-hardening, water resistant, fire resistive and shall not be a solvent curing product. Sealants shall be compatible with mating materials, liquid used alone or with tape or heavy mastic.

D. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

1. For exposed stainless steel ductwork, provide matching stainless steel support materials.
2. For aluminum ductwork, provide aluminum support materials.

2.3 LOW PRESSURE DUCTWORK

A. Fabricate and support in accordance with latest SMACNA Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by approved shop drawings. Obtain engineer’s approval prior to using round duct in lieu of rectangular duct.

C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

E. Use crimp joints with bead for joining round duct sizes 6 inch smaller with crimp in direction of airflow.

F. Use double nuts and lock washers on threaded rod supports.

2.4 MEDIUM AND HIGH PRESSURE DUCTS

A. Fabricate and support in accordance with SMACNA Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. Construct T's, bends, and elbows with radius of not less than 1½ times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is required, provide turning vanes of perforated metal with glass fiber insulation. Weld in place.

C. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

D. Fabricate continuously welded medium and high pressure round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

2.5 CHLORINE STORAGE AREA

A. 18 gauge minimum galvanized steel.

B. Three coat minimum, acid resistance, epoxy paint, minimum 6 mil dry film thickness total, inside of duct and outside of duct.

C. Paint after fabrication including all taps and grilles.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Obtain manufacturer's inspection and acceptance of fabrication and installation of ductwork at beginning of installation.

B. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

D. Connect terminal units to medium or high pressure ducts with four feet maximum length of flexible duct. Do not use flexible duct to change direction.

E. Connect diffusers or troffer boots to low pressure ducts with 6 feet maximum, 4 feet minimum, length of flexible duct. Hold in place with strap or clamp.

F. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

G. The interior surface of all ductwork shall be smooth. No sheet metal parts, tabs, angles, or anything else may project into the ducts for any reason, except as specified to be so. All seams and joints shall be external.

H. All ductwork located exposed on roof shall be "crowned" to prevent water from ponding. Ref: Insulation for additional requirements.

I. Where ducts pass through floors, provide structural angles for duct support. Where ducts pass through walls in exposed areas, install suitable sheet metal escutcheons as closers.

J. All angles shall be carried around all four sides of the duct or group of ducts. Angles shall overlap corners and be welded or riveted.

K. All ductwork shall be fabricated in a manner to prevent the seams or joints being cut for the installation of grilles, registers, or ceiling outlets.

L. All duct hangers shall be attached to building structure. Cutting slots in roof or floor decking for hanger straps to be cast in concrete is not acceptable.

3.2 INSTALLATION OF FLEXIBLE DUCTS

A. Maximum Length: For any duct run using flexible ductwork, do not exceed 6'-0" extended length.

B. Installation: Install in accordance with Section III of SMACNA’s, “HVAC Duct Construction Standards, Metal and Flexible”.

3.3 DUCTWORK APPLICATION SCHEDULE

AIR SYSTEM	MATERIAL
Low Pressure Supply	Galvanized Steel, Aluminum
Medium and High Pressure Supply	Galvanized Steel
Return and Relief	Galvanized Steel, Aluminum
General Exhaust	Galvanized Steel, Aluminum
Fume Hood Exhaust	Stainless Steel, Glass Fiber Reinforced Plastic if not in air plenum.
Outside Air Intake	Galvanized Steel

3.4 DUCTWORK HANGERS AND SUPPORTS

A. All ductwork shall be properly suspended or supported from the building structure. Hangers shall be galvanized steel straps or hot-dipped galvanized rod with threads pointed after installation. Strap hanger shall be attached to the bottom of the ductwork, provide a minimum of two screws one at the bottom and one in the side of each strap on metal ductwork. The spacing, size and installation of hangers shall be in accordance with the recommendations of the latest SMACNA edition.

B. All duct risers shall be supported by angles or channels secured to the sides of the ducts at each floor with sheet metal screws or rivets. The floor supports may also be secured to ducts by rods, angles or flat bar to the duct joint or reinforcing. Structural steel supports for duct risers shall be provided under this Division.

3.5 AIR DUCT LEAKAGE: (From SMACNA Duct Standards Latest Edition) Test all ductwork (designed to handle over 1000 CFM) as follows:

A. Test apparatus

The test apparatus shall consist of:

1. A source of high pressure air--a portable rotary blower or a tank type vacuum cleaner.
2. A flow measuring device consisting of straightening vanes and an orifice plate mounted in a straight tube with properly located pressure taps. Each orifice assembly shall be accurately calibrated with its own calibration curve. Pressure and flow readings shall be taken with U-tube manometers.

B. Test Procedures

1. Test for audible leaks as follows:
2. Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.
   a. Start the blower with its control damper closed.
   b. Gradually open the inlet damper until the duct pressure reaches 1.5 times the standard designed duct operating pressure.
   c. Survey all joint for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.
3. After all audible leaks have been sealed, the remaining leakage should be measured with the orifice section of the test apparatus as follows:
   a. Start blower and open damper until pressure in duct reaches 50% in excess of designed duct operating pressure.
   b. Read the pressure differential across the orifice on manometer No. 2. If there is no leakage, the pressure differential will be zero.
   c. Total allowable leakage shall not exceed one (1) percent of the total system design air flow rate. When partial sections of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
   d. Even though a system may pass the measured leakage test, a concentration of leakage at one point may result in a noisy leak which, must be corrected.
4. Testing Report
   a. Contractor shall provide a testing report for each air system to the engineer. The report shall indicate the completion of testing and compliance with testing specification.
   b. All duct testing reports shall be included in the final close out documents.

3.6 DUCT SYSTEM PROTECTION

A. Provide temporary closures at the ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation; provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.

B. Provide temporary construction filters on air handling equipment and/or return air ductwork during construction to protect ductwork and equipment from dust.

C. Any ductwork stored on site with observable dirt or debris inside shall be cleaned by a third party.

D. If the air handling system has been operated without temporary construction filters or if the integrity of the temporary closures has been compromised, the contractor shall have the duct system cleaned per the following section.

3.7 DUCT JOINTS AND SEAMS

A. All ductwork shall be constructed to Seal Class A, as referenced in SMACNA Standards.

B. All non-welded joints and seams shall be sealed. This includes but is not limited to:

1. Transverse joints.
2. Longitudinal seams.
3. Duct wall penetrations.
4. Spin-ins, taps, and other branch connections.
5. Access doors, access panels, and duct connections to equipment.

C. Openings for rotating shafts shall be sealed with bushings.

END OF SECTION

SECTION 23 34 00 – HVAC FANS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

B. Section 23 02 00 - Basic Materials and Methods is included as a part of this Section as though written in full in this document.

1.2 WORK INCLUDED

A. Centrifugal roof ventilators.

1.3 RELATED SECTIONS

A. Section 23 05 13 – Common Motor Requirements for HVAC Equipment

B. Section 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment

C. Section 23 05 93 – Testing, Adjusting and Balancing

1.4 QUALITY ASSURANCE

A. UL Compliance: Fans shall be designed, manufactured, and tested in accordance with UL 705 "Power Ventilators."

B. UL Compliance: Fans and components shall be UL listed and labeled.

C. Nationally Recognized Testing Laboratory Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

F. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.

G. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections:

B. Product data for selected models, including specialties, accessories, and the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound power ratings.
3. Motor ratings and electrical characteristics plus motor and fan accessories.
4. Materials, gages and finishes, include color charts.
5. Dampers, including housings, linkages, and operators.
6. Full color paint samples.

C. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.

D. Coordination drawings, in accordance with Division 23, Section "Basic Materials and Methods", for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension members.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinkler heads, access panels, and special moldings.

F. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer installed wiring and field installed wiring.

G. Product certificates, signed by manufacturer, certifying that their products comply with specified requirements.

H. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 23, Section "Basic Materials and Methods".

1.6 DELIVERY, STORAGE, AND HANDLING

A. Fans shall be stored and handled in accordance with the unit manufacturer’s instructions.

B. Lift and support units with the manufacturer's designated lifting or supporting points.

C. Disassemble and reassemble units as required for movement into the final location following manufacturer's written instructions.

D. Deliver fan units as a factory-assembled unit to the extent allowable by shipping limitations, with protective crating and covering.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.8 OPERATIONS PERSONNEL TRAINING

A. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject system/equipment.

Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Greenheck Fan Corporation

B. Loren Cook Company

C. PennBarry

D. ACME

E. Twin City Fan and Blower

2.2 GENERAL DESCRIPTION

A. Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.

B. Fans and Shafts shall be statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.

C. Provide factory baked-enamel finish coat after assembly. Color for roof mounted fans shall be chosen by Architect during the submittal process.

2.3 CENTRIFUGAL ROOF VENTILATORS

A. Fan shall be a spun aluminum, centrifugal, roof mounted, direct driven or belt driven as indicated.

B. Fan shall be listed by Underwriters Laboratories (UL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.

C. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16 gauge marine alloy aluminum, bolted to a rigid aluminum support structure.

D. The aluminum base shall have continuously welded curb cap corners for maximum leak protection. A discharge baffle conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections.

E. The motor, bearings and drives shall be mounted on a minimum 14 gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust airstream. Unit shall bear an engraved aluminum nameplate and shall be shipped in transit tested packaging.

F. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA standard 204-96, balance quality and vibration levels for fans.

G. Motor shall be heavy duty type with permanently lubricated sealed ball bearings.

H. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty re-greaseable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

I. Accessories: The following accessories are required.

1. Disconnect Switch: Non-fusible type, with thermal overload protection, mounted inside fan housing, factory-wired through an internal aluminum conduit.
2. Bird Screens: Removable ½ inch mesh, 16 gauge, aluminum or brass wire.
3. Dampers: Gravity backdraft damper or motorized shutoff damper mounted in accessible location. Refer to 23 33 00 – Ductwork Accessories.
4. Roof Curbs: Prefabricated, 12 inch high, heavy-gauge, galvanized steel; mitered and welded corners; 2 inch thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2 inch wood nailer. Size as required to suit roof opening and fan base. Roof curb shall match roof slope so that the curb is level.

PART 3 – EXECUTION

1.1 Install in accordance with manufacturer's instructions.

1.2 All items required for a complete and proper installation are not necessarily indicated on the plans or in the specifications. Provide all items required as per manufacturer's requirements.

END OF SECTION

SECTION 23 83 13 – RADIANT HEATING ELECTRIC CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Heating cable.

B. Temperature controllers for heating cable.

1.2 RELATED SECTIONS

A. Section 22 10 00 - Plumbing Piping and Pumps.

1.3 BASIC MATERIALS AND METHODS

A. Section 23 21 13 – Above Ground Hydronic Piping.

1.4 PERFORMANCE REQUIREMENTS

A. Pipe Trace Heating: Freeze protection with outside temperature at 27 degrees.

1.5 SUBMITTALS

A. Submit under provisions of Division One.

B. Shop Drawings: Indicate heating cable layout, locations of terminations, thermostats, and branch circuit connections.

C. Product Data: Provide data for heating cable, and control components.

D. Manufacturer's Installation Instructions: Indicate installation instructions.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Accurately record actual locations of heating cable, temperature sensors, thermostats, and branch circuit connections.

1.7 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division One.

B. Operation Data: Include description of operating controls.

C. Maintenance Data: Include repair methods and parts list of components.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum [three] years documented experience.

1.9 PRE-INSTALLATION CONFERENCE

A. Convene one week prior to commencing work of this Section, under provisions of Section

01039.

B. Require attendance of parties directly affecting the work of this Section.

C. Review sequencing of installation, protection from damage of finished installation, and methods used for covering installations with insulation.

1.10 COORDINATION

A. Coordinate Work under provisions of Section 01039.

B. Coordinate installation of heating cable with installation of roofing and gutters, piping, and piping insulation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Chromalox.

B. Thermon.

C. Watlow.

D. Substitutions: Under provisions of Division One.

2.2 HEATING CABLE

A. Heating Cable: Self-regulating, parallel resistance heating cable, semiconductive polymer code, electrical resistance varies with temperature.

B. Rating: 277V, 5 W/lineal ft.

2.3 ACCESSORIES

A. Thermostat: Ambient-sensing.

B. Snow Detector:

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that piping is ready to receive heat cable.

B. Verify field measurements are as shown on Drawings.

C. Verify that required electrical services are available, in proper location, and ready for use.

D. Beginning of installation means installer accepts conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Bending Radius: Six times cable diameter, minimum.

C. Avoid pinching and making sharp bends in cable.

D. Prevent damage by sharp metal, or other objects during installation.

E. Do not install heating cable across expansion or construction joints.

F. Do not cross heating cable over itself.

G. Route and fasten cable in accordance with manufacturer's instructions. Select and install cable based on maximum safe temperature for materials used.

3.3 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Division One.

B. Test continuity of heating cable.

C. Measure insulation resistance to manufacturer's recommended values. Use test instruments in accordance with manufacturer's instructions.

D. Perform continuity and insulation resistance test on completed cable installation.

E. Measure voltage and current at each unit.

F. Submit written test report showing values measured on each test for each cable.

3.4 DEMONSTRATION

A. Provide systems demonstration under provisions of Division One.

B. Demonstrate operation of heating cable controls.

END OF SECTION

SECTION 26 02 00 - BASIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all Work herein.

B. The Contract Drawings indicate the extent and general arrangement of the systems. If any departure from the Contract Drawings are deemed necessary by the Contractor, details of such departures and the reasons therefore, shall be submitted to the Architect for approval as soon as practicable. No such departures shall be made without the prior written approval of the Architect.

1.2 SCOPE OF WORK

A. The Work included under this Contract consists of the furnishing and installation of all equipment and material necessary and required to form the complete and functioning systems in all of its various phases, all as shown on the accompanying Drawings and/or described in these Specifications. The contractor shall review all pertinent drawings, including those of other contracts prior to commencement of Work.

B. This Division requires the furnishing and installing of all items Specified herein, indicated on the Drawings or reasonably inferred as necessary for safe and proper operation; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include, but are not limited to, materials, labor, supervision, transportation, storage, equipment, utilities, all required permits, licenses and inspections. All work performed under this Section shall be in accordance with the Project Manual, Drawings and Specifications and is subject to the terms and conditions of the Contract.

C. The approximate locations of Electrical items are indicated on the Drawings. These Drawings are not intended to give complete and accurate details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the building, and will in all cases be subject to the Review of the Owner or Engineer, who reserves the right to make any reasonable changes in the locations indicated without additional cost to the Owner.

D. Items specifically mentioned in the Specifications but not shown on the Drawings and/or items shown on Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

E. All discrepancies within the Contract Documents, or discrepancies between the Contract Documents and actual job-site conditions shall be reported to the Owner or Engineer so that they will be resolved prior to the bidding, where this cannot be done at least 7 working days prior to bid; the greater or more costly of the discrepancy shall be bid. All labor and materials required to perform the work described shall be included as part of this Contract.

F. It is the intention of this Section of the Specifications to outline minimum requirements to furnish the Owner with a turn-key and fully operating system in cooperation with other trades.

G. It is the intent of the above "Scope" to give the Contractor a general outline of the extent of the Work involved; however, it is not intended to include each and every item required for the Work. Anything omitted from the "Scope" but shown on the Drawings, or specified later, or necessary for a complete and functioning heating, ventilating and air conditioning system shall be considered a part of the overall "Scope".

H. The Contractor shall rough-in fixtures and equipment furnished by others from rough-in and placement drawings furnished by others. The Contractor shall make final connection to fixtures and equipment furnished by others.

I. Contractor shall participate in the commissioning process; including but not limited to meeting attendance, completion of checklists and participation in functional testing.

1.3 RELATED SECTIONS

A. General Conditions

B. Supplementary Conditions

C. Division One

1.4 COOPERATION WITH TRADES:

A. Cooperation with trades of adjacent, related, or affected materials or operations shall be considered a part of this work in order to affect timely and accurate placing of work and bring together in proper and correct sequence, the work of such trades.

1.5 REFERENCES

A. National Electrical Code (NEC)

B. American Society for Testing and Materials (ASTM)

C. Underwriter's Laboratories, Inc. (UL)

D. Insulated Cable Engineer's Association (ICEA).

E. National Electrical Manufacturer's Association (NEMA).

F. Institute of Electrical and Electronic's Engineers (IEEE).

G. American National Standards Institute (ANSI).

H. National Fire Protection Association (NFPA).

I. International Energy Conservation Code (IECC).

1.6 COMPLETE FUNCTIONING OF WORK:

A. All work fairly implied as essential to the complete functioning of the electrical systems shown on the Drawings and Specifications shall be completed as part of the work of this Division unless specifically stated otherwise. It is the intention of the Drawings and Specifications to establish the types of the systems, but not set forth each item essential to the functioning of the system. In case of doubt as to the work intended, or in the event of amplification or clarification thereof, the Contractor shall call upon the Architect for supplementary instructions, Drawings, etc.

B. Contractor shall review all pertinent Drawings and adjust his work to all conditions shown there on. Discrepancies between Plans, Specifications, and actual field conditions shall be brought to the prompt attention of the Architect.

1. Approximate location of transformers, feeders, branch circuits, outlets, lighting and power panels, outlets for special systems, etc., are indicated on the Drawings. However, the Drawings, do not give complete and accurate detailed locations of such outlets, conduit runs, etc., and exact locations must be determined by actual field measurement. Such locations will, at all times, be subject to the approval of the Architect.
2. Communicate with the Architect and secure his approval of any outlet (lighting fixture, receptacle, switch, etc.) location about which there may be the least question. Outlets obviously placed in a location not suitable to the finished room or without specific approval, shall be removed and relocated when so directed by the Architect. Location of lighting fixtures shall be coordinated with reflected ceiling plans.

C. Additional coordination with mechanical contractor may be required to allow adequate clearances of mechanical equipment, fixtures and associated appurtenances. Contractor to notify Architect and Engineer of unresolved clearances, conflicts or equipment locations.

1.7 SCHEMATIC NATURE OF CONTRACT DOCUMENTS

A. The contract documents are schematic in nature in that they are only to establish scope and a minimum level of quality. They are not to be used as actual working construction drawings. The actual working construction drawings shall be the approved shop drawings.

1.8 CONTRACTOR'S QUALIFICATIONS

A. An approved contractor for the work under this division shall be:

1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that have served their Owners satisfactorily for not less than 3 years.
3. Perform work by persons qualified to produce workmanship of specified quality. Persons performing electrical work shall be required to be licensed. Onsite supervision, journeyman shall have minimum of journeyman license. Helpers, apprentices shall have minimum of apprentice license.

1.9 DATE OF FINAL ACCEPTANCE

A. The date of final acceptance shall be the date of owner occupancy, or the date all punch list items have been completed or final payment has been received. Refer to Division One for additional requirements.

B. The date of final acceptance shall be documented in writing and signed by the architect, owner and contractor.

1.10 DEFINITIONS AND SYMBOLS

A. General Explanation: A substantial amount of construction and Specification language constitutes definitions for terms found in other Contract Documents, including Drawings which must be recognized as diagrammatic and schematic in nature and not completely descriptive of requirements indicated thereon. Certain terms used in Contract Documents are defined generally in this article, unless defined otherwise in Division 1.

B. Definitions and explanations of this Section are not necessarily either complete or exclusive but are general for work to the extent not stated more explicitly in another provision of the Contract Documents.

C. Indicated: The term "Indicated" is a cross-reference to details, notes or schedules on the Drawings, to other paragraphs or schedules in the Specifications and to similar means of recording requirements in Contract Documents. Where such terms as "Shown", "Noted", "Scheduled", "Specified" and "Detailed" are used in lieu of "Indicated", it is for the purpose of helping the reader locate cross-reference material, and no limitation of location is intended except as specifically shown.

D. Directed: Where not otherwise explained, terms such as "Directed", "Requested", "Accepted", and "Permitted" mean by the Architect or Engineer. However, no such implied meaning will be interpreted to extend the Architect's or Engineer's responsibility into the Contractor's area of construction supervision.

E. Reviewed: Where used in conjunction with the Engineer's response to submittals, requests for information, applications, inquiries, reports and claims by the Contractor the meaning of the term "Reviewed" will be held to limitations of Architect's and Engineer's responsibilities and duties as specified in the General and Supplemental Conditions. In no case will "Reviewed" by Engineer be interpreted as a release of the Contractor from responsibility to fulfill the terms and requirements of the Contract Documents.

F. Furnish: Except as otherwise defined in greater detail, the term "Furnish" is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

G. Install: Except as otherwise defined in greater detail, the term "Install" is used to describe operations at the project site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance.

H. Provide: Except as otherwise defined in greater detail, the term "Provide" is used to mean "Furnish and Install", complete and ready for intended use, as applicable in each instance.

I. Installer: Entity (person or firm) engaged by the Contractor or its subcontractor or Sub-contractor for performance of a particular unit of work at the project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protection, cleaning and similar operations, as applicable in each instance. It is a general requirement that such entities (Installers) be expert in the operations they are engaged to perform.

J. Imperative Language: Used generally in Specifications. Except as otherwise indicated, requirements expressed imperatively are to be performed by the Contractor. For clarity of reading at certain locations, contrasting subjective language is used to describe responsibilities that must be fulfilled indirectly by the Contractor, or when so noted by other identified installers or entities.

K. Minimum Quality/Quantity: In every instance, the quality level or quantity shown or specified is intended as minimum quality level or quantity of work to be performed or provided. Except as otherwise specifically indicated, the actual work may either comply exactly with that minimum (within specified tolerances), or may exceed that minimum within reasonable tolerance limits. In complying with requirements, indicated or scheduled numeric values are either minimums or maximums as noted or as appropriate for the context of the requirements. Refer instances of uncertainty to Owner or Engineer via a request for information (RFI) for decision before proceeding.

L. Abbreviations and Symbols: The language of Specifications and other Contract Documents including Drawings is of an abbreviated type in certain instances, and implies words and meanings which will be appropriately interpreted. Actual word abbreviations of a self explanatory nature have been included in text of Specifications and Drawings. Specific abbreviations and symbols have been established, principally for lengthy technical terminology and primarily in conjunction with coordination of Specification requirements with notations on Drawings and in Schedules. These are frequently defined in Section at first instance of use or on a Legend and Symbol Drawing. Trade and industry association names and titles of generally recognized industry standards are frequently abbreviated. Singular words will be interpreted as plural and plural words will be interpreted as singular where applicable and where full context of Contract Documents so indicate. Except as otherwise indicated, graphic symbols and abbreviations used on Drawings and in Specifications are those recognized in construction industry for indicated purposes. Where not otherwise noted symbols and abbreviations are defined by 1993 ASHRAE Fundamentals Handbook, chapter 34 "Abbreviations and Symbols", ASME and ASPE published standards.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Deliver products to the project at such time as the project is ready to receive the equipment, pipe or duct properly protected from incidental damage and weather damage.

C. Damaged equipment shall be promptly removed from the site and new, undamaged equipment shall be installed in its place promptly with no additional charge to the Owner.

1.12 SUBMITTALS

A. Coordinate with Division 01 for submittal timetable requirements, unless noted otherwise within thirty (30) days after the Contract is awarded. The Contractor shall submit an electronic copy of a complete set of shop drawings and complete data covering each item of equipment or material. The submittal of each item requiring a submittal must be received by the Architect or Engineer within the above thirty day period. The Architect or Engineer shall not be responsible for any delays or costs incurred due to excessive shop drawing review time for submittals received after the thirty (30) day time limit. The Architect and Engineer will retain a copy of all shop drawings for their files. All literature pertaining to items subject to Shop Drawing submittal shall be submitted at one time. Submittals shall be placed in one electronic file in PDF 8.0 format and bookmarked for individual specification sections. Individual electronic files of submittals for individual specifications shall not be permitted. Each submittal shall include the following items:

1. A cover sheet with the names and addresses of the Project, Architect, MEP Engineer, General Contractor and the Subcontractor making the submittal. The cover sheet shall also contain the section number covering the item or items submitted and the item nomenclature or description.

2. An index page with a listing of all data included in the Submittal.
3. A list of variations page with a listing all variations, including unfurnished or additional required accessories, items or other features, between the submitted equipment and the specified equipment. If there are no variations, then this page shall state "NO VARIATIONS". Where variations affect the work of other Contractors, then the Contractor shall certify on this page that these variations have been fully coordinated with the affected Contractors and that all expenses associated with the variations will be paid by the submitting Contractor. This page will be signed by the submitting Contractor.
4. Equipment information including manufacturer's name and designation, size, performance and capacity data as applicable. All applicable Listings, Labels, Approvals and Standards shall be clearly indicated.
5. Dimensional data and scaled drawings as applicable to show that the submitted equipment will fit the space available with all required Code and maintenance clearances clearly indicated and labeled at a minimum scale of 1/4" = 1'-0", as required to demonstrate that the alternate or substituted product will fit in the space available.
6. Identification of each item of material or equipment matching that indicated on the Drawings.
7. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements or accessories shall be so indicated. All applicable information shall be clearly indicated with arrows or another approved method.
8. Additional information as required in other Sections of this Division.
9. Certification by the General Contractor and Subcontractor that the material submitted is in accordance with the Drawings and Specifications, signed and dated in long hand. Submittals that do not comply with the above requirements shall be returned to the Contractor and shall be marked "**REVISE AND RESUBMIT**".

B. Refer to Division 1 for additional information on shop drawings and submittals.

C. Equipment and materials submittals and shop drawings will be reviewed for compliance with design concept only. It will be assumed that the submitting Contractor has verified that all items submitted can be installed in the space allotted. Review of shop drawings and submittals shall not be considered as a verification or guarantee of measurements or building conditions.

D. Where shop drawings and submittals are marked "**REVIEWED**", the review of the submittal does not indicate that submittals have been checked in detail nor does it in any way relieve the Contractor from his responsibility to furnish material and perform work as required by the Contract Documents.

E. Shop drawings shall be reviewed and returned to the Contractor with one of the following categories indicated:

1. **REVIEWED:** Contractor need take no further submittal action, shall include this submittal in the O&M manual and may order the equipment submitted on.
2. **REVIEWED AS NOTED:** Contractor shall submit a letter verifying that required exceptions to the submittal have been received and complied with including additional accessories or coordination action as noted, and shall include this submittal and compliance letter in the O&M manual. The contractor may order the equipment submitted on at the time of the returned submittal providing the Contractor complies with the exceptions noted.
3. **NOT APPROVED:** Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is not

approved, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or drawings. Contractor shall not order equipment that is not approved. Repetitive requests for substitutions will not be considered.

4. **REVISE AND RESUBMIT:** Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked revise and resubmit, the Contractor will automatically be required to furnish the product, material or method named in the Specifications and/or provide as noted on previous shop drawings. Contractor shall not order equipment marked revise and resubmit. Repetitive requests for substitutions will not be considered.
5. **CONTRACTOR'S CERTIFICATION REQUIRED:** Contractor shall resubmit submittal on material, equipment or method of installation. The Contractor's stamp is required stating the submittal meets all conditions of the contract documents. The stamp shall be signed by the General Contractor. The submittal will not be reviewed if the stamp is not placed and signed on all shop drawings.
6. **MANUFACTURER NOT AS SPECIFIED:** Contractor shall resubmit new submittal on material, equipment or method of installation when the alternate or substitute is marked manufacturer not as specified, the Contractor will automatically be required to furnish the product, material or method named in the specifications. Contractor shall not order equipment where submittal is marked manufacturer not as specified. Repetitive requests for substitutions will not be considered.

F. Materials and equipment which are purchased or installed without shop drawing review shall be at the risk of the Contractor and the cost for removal and replacement of such materials and equipment and related work which is judged unsatisfactory by the Owner or Engineer for any reason shall be at the expense of the Contractor. The responsible Contractor shall remove the material and equipment noted above and replace with specified equipment or material at his own expense when directed in writing by the Architect or Engineer.

G. Shop Drawing Submittals shall be complete and checked prior to submission to the Engineer for review.

H. Furnish detailed shop drawings, descriptive literature, table of contents listing all items being submitted at the beginning of each submittal package, physical data and a specification critique for each section indicating "compliance" and/or "variations" for the following items:

Distribution Panelboards
Panelboards
Wiring Gutters
Heavy Duty Disconnect Switches
Lighting Fixtures
Lighting Contactors
Time Clocks
Lighting Control System
Photocells
Wiring Devices and Plates
Conduit and Fittings
Wire
Surge Protection Device (SPD)

I. Refer to each specification section for additional requirements.

1.13 OPERATION AND MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 and in addition to the requirements specified in Division 1, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

1.14 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of pipe, duct, equipment, and other materials. Include the following:
   a. Wall and type locations.
   b. Clearances for installing and maintaining insulation.
   c. Locations of light fixtures and sprinkler heads.
   d. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
   e. Equipment connections and support details.
   f. Exterior wall and foundation penetrations.
   g. Routing of storm and sanitary sewer piping.
   h. Fire-rated wall and floor penetrations.
   i. Sizes and location of required concrete pads and bases.
   j. Valve stem movement.
   k. Structural floor, wall and roof opening sizes and details.
2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air distribution devices, light fixtures, communication systems components, and other ceiling-mounted items.

B. This Contractor shall be responsible for coordination of all items that will affect the installation of the work of this Division. This coordination shall include, but not be limited to: voltage, ampacity, capacity, electrical and piping connections, space requirements, sequence of construction, building requirements and special conditions.

C. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other Contractors and Subcontractors.

1.15 RECORD DRAWINGS

A. Maintain a continuous record during the course of construction of all changes and deviations in the work from the contract drawings. Upon completion of the work, purchase a set of "Auto Positive Tracings" on vellum and make corrections as required to reflect the electrical systems as installed. Location and size of all conduit shall be accurately shown to dimension. Submit three prints of the tracings for approval. Make corrections to tracings as directed and deliver "Auto Positive Tracings" to the Architect. Record drawings shall be furnished in addition to shop drawings. Symbols on the Record drawings shall correspond to the identification symbols on the contract drawings and equipment identification plates and tags.

B. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.

C. Refer to Division 1 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as-built prints and reproducibles is a condition of final acceptance.

D. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.

E. Submit three prints of the tracings for approval. Make corrections to tracings as directed and delivered "Auto Positive Tracings" to the architect. "As-Built" drawings shall be furnished in addition to shop drawings.

F. When the option described above is not exercised then upon completion of the work, the Contractor shall transfer all marks to a clear, concise, set of reproducible, record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineers Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as follows:

CERTIFIED RECORD DRAWINGS

DATE:

(NAME OF GENERAL CONTRACTOR)

BY:_____
(SIGNATURE)

(NAME OF SUBCONTRACTOR)

BY:_____
(SIGNATURE)

1.16 CERTIFICATIONS AND TEST REPORTS

A. Submit a detailed schedule for completion and testing of each system indicating scheduled dates for completion of system installation and outlining tests to be performed and schedule date for each test. This detailed completion and test schedule shall be submittal at least 90 days before the projected Project completion date.

B. Test result reporting forms shall be submitted for review no later than the date of the detailed schedule submitted.

C. Submit 4 copies of all certifications and test reports to the Architect or Engineer for review adequately in advance of completion of the Work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

D. Certifications and test reports to be submitted shall include, but not be limited to those items outlined in Section of Division 26.

1.17 MAINTENANCE MANUALS

A. Coordinate with Division 1 for maintenance manual requirements, unless noted otherwise bind together in “D ring type” binders by National model no. 79-883 or equal, binders shall be large enough to allow ¼” of spare capacity. Three (3) sets of all approved shop drawing submittals, fabrication drawings, bulletins, maintenance instructions, operating instructions and parts exploded views and lists for each and every piece of equipment furnished under this Specification. All sections shall be typed and indexed into sections and labeled for easy reference and shall utilize the individual specification section numbers shown in the Electrical Specifications as an organization guideline. Bulletins containing information about equipment that is not installed on the project shall be properly marked up or stripped and reassembled. All pertinent information required by the Owner for proper operation and maintenance of equipment supplied by Division 26 shall be clearly and legibly set forth in memoranda that shall, likewise, be bound with bulletins.

B. Prepare maintenance manuals in accordance with Special Project Conditions, in addition to the requirements specified in Division 26, include the following information for equipment items:

1. Identifying names, name tags designations and locations for all equipment.
2. Fault Current calculations and Coordination Study.
3. Reviewed shop drawing submittals with exceptions noted compliance letter.
4. Fabrication drawings.
5. Equipment and device bulletins and data sheets clearly highlighted to show equipment installed on the project and including performance curves and data as applicable, i.e., description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and model numbers of replacement parts.
6. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

7. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions, servicing instructions and lubrication charts and schedules.
8. Equipment name plate data.
9. Wiring diagrams.
10. Exploded parts views and parts lists for all equipment and devices.
11. Color coding charts for all painted equipment and conduit.
12. Location and listing of all spare parts and special keys and tools furnished to the Owner.
13. Furnish recommended lubrication schedule for all required lubrication points with listing of type and approximate amount of lubricant required.

C. Refer to Division 1 for additional information on Operating and Maintenance Manuals.

D. Operating and Maintenance Manuals shall be turned over to the Owner or Engineer a minimum of 14 working days prior to the beginning of the operator training period.

1.18 OPERATOR TRAINING

A. The Contractor shall furnish the services of factory trained specialists to instruct the Owner's operating personnel. The Owner's operator training shall include 12 hours of onsite training in three 4 hour shifts.

B. Before proceeding with the instruction of Owner Personnel, prepare a typed outline in triplicate, listing the subjects that will be covered in this instruction, and submit the outline for review by the Owner. At the conclusion of the instruction period obtain the signature of each person being instructed on each copy of the reviewed outline to signify that he has a proper understanding of the operation and maintenance of the systems and resubmit the signed outlines.

C. Refer to other Division 26 Sections for additional Operator Training requirements.

1.19 SITE VISITATION

A. Visit the site of the proposed construction in order to fully understand the facilities, difficulties and restriction attending the execution of the work.

B. Before submitting a bid, it will be necessary for each Contractor whose work is involved to visit the site and ascertain for himself the conditions to be met therein in installing his work and make due provision for same in his bid. It will be assumed that this Contractor in submitting his bid has visited the premises and that his bid covers all work necessary to properly install the equipment shown. Failure on the part of the Contractor to comply with this requirement shall not be considered justification for the omission or faulty installation of any work covered by these Specifications and Drawings.

C. Understand the existing utilities from which services will be supplied; verify locations of utility services and determine requirements for connections.

D. Determine in advance that equipment and materials proposed for installation fit into the confines indicated.

1.20 WARRANTY

A. The undertaking of the work described in this Division shall be considered equivalent to the issuance, as part of this work, of a specific guarantee extending one year beyond the date of completion of work and acceptance by Owner, against defects in materials and

workmanship. Materials, appliances and labor necessary to effect repairs and replacement so as to maintain said work in good functioning order shall be provided as required. Replacements necessitated by normal wear in use or by Owner's abuse are not included under this guarantee.

B. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, freight/shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service call required to diagnose warranty problems.

1.21 TRANSFER OF ELECTRONIC FILES

A. Project documents are not intended or represented to be suitable for reuse by Architect/Owner or others on extensions of this project or on any other project. Any such reuse or modification without written verification or adaptation by Engineer, as appropriate for the specific purpose intended, will be at Architect/Owner’s risk and without liability or legal exposure to Engineer or its consultants from all claims, damages, losses and expense, including attorney’s fees arising out of or resulting thereof.

B. Because data stored in electric media format can deteriorate or be modified inadvertently, or otherwise without authorization of the data’s creator, the party receiving the electronic files agrees that it will perform acceptance tests or procedures within sixty (60) days of receipt, after which time the receiving party shall be deemed to have accepted the data thus transferred to be acceptable. Any errors detected within the sixty (60) day acceptance period will be corrected by the party delivering the electronic files. Engineer is not responsible for maintaining documents stored in electronic media format after acceptance by the Architect/Owner.

C. When transferring documents in electronic media format, Engineer makes no representations as to the long term compatibility, usability or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by Engineer at the beginning of the Project.

D. Any reuse or modifications will be Contractor’s sole risk and without liability or legal exposure to Architect, Engineer or any consultant.

E. The Texas Board of Architectural Examiners (TBAE) has stated that it is in violation of Texas law for persons other than the Architect of record to revise the Architectural drawings without the Architect’s written consent.

1. It is agreed that “MEP” hard copy or computer-generated documents will not be issued to any other party except directly to the Architect/Owner. The contract documents are contractually copyrighted and cannot be used for any other project or purpose except as specifically indicated in AIA B-141 Standard Form of Agreement Between Architect and Owner.

2. If the client, Architect/Owner, or developer of the project requires electronic media for “record purposes”, then an AutoCAD/Revit documents will be prepared by the Engineer on electronic media such as removable memory devices, flash drives, or CD’s. These documents can also be submitted via file transfer protocols. AutoCAD/Revit files will be submitted with all title block references intact to permit the end user to only view and plot the drawings. Revisions will not be permitted in this configuration.

3. At the Architect/Owner’s request, Engineer will assist the contractor in the preparation of the submittals and prepare one copy of AutoCAD/Revit files on electronic media or submit through file transfer protocols. The electronic media

will be prepared with all indicia of documents ownership removed. The electronic media will be prepared in a ".rvt" or ".dwg" format to permit the end user to revise the drawings.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. The names and manufacturers and model numbers have been used in the Contract documents to establish types of equipment and standards of quality. Where more than one manufacturer is named for a specific item of equipment, only one of the specified manufacturers will be considered for approval. Where only one manufacturer is mentioned with the phrase "or approved equal", Contractor may submit an alternate manufacturer for consideration, provided the following conditions are met:

1. Submit alternate equipment with complete descriptive data in shop drawing form. Provide sample of equipment upon request for review by Architect. Samples will be returned if requested in writing.
2. Alternate equipment must be equal from the standpoint of materials, construction and performance.
3. Alternate submittal must be presented to the Engineer/Architect ten (10) days prior to bid date for approval.

B. The Architect and Engineer shall be the sole judge of quality and equivalence of equipment, materials and methods.

2.2 All materials and products used on this project shall be listed by Underwriters' Laboratories.

2.3 ACCESS DOORS

A. Wherever access is required in walls or ceilings to concealed junction boxes, pull boxes, equipment, etc., installed under this Division, furnish a hinged access door and frame with flush latch handle to another Division for installation. Doors shall be as follows:

1. Plaster Surfaces: Milcor Style K.
2. Ceramic Tile Surfaces: Milcor Style M.
3. Drywall Surfaces: Milcor Style DW.
4. Install panels only in locations approved by the Architect.

2.4 EQUIPMENT PADS

A. Provide 4-inch high concrete pads for indoor floor mounted equipment. Pads shall conform to the shape of the equipment with a minimum of 6 inches beyond the equipment. Top and sides of pads shall be troweled to a smooth finish, equivalent to the floor. External corners shall be bullnosed to a 3/4-inch radius, unless shown otherwise.

B. Provide 6-inch high concrete pads for all exterior mounted equipment. Pads shall conform to the shape of the equipment with a minimum of 6 inches beyond the equipment. Provide a 4-foot monolithic extension to the pad in front of the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.). Top and sides of pads shall be troweled to a smooth finish. External corners shall be bullnosed to a 3/4-inch radius, unless shown otherwise

C. Provide a minimum 6-inch high, steel reinforced concrete pad for generators. Pads shall be 6 inches larger than the outside perimeter dimensions. Provide a 4-foot monolithic extension to the pad around the equipment for service when mounted on a non-finished area (i.e. landscape, gravel, clay, etc.). Refer to structural details. Top and sides of pads

shall be troweled to a smooth finish. External corners shall be bullnosed to a 3/4-inch radius, unless shown otherwise. The Generator shall be bolted to the pad per the manufacturer's recommendations.

D. Provide steel reinforced concrete pad for utility transformers. Pads shall comply with Utility Company Standards.

2.5 ESCUTCHEONS

A. Provide heavy chrome or nickel plated plates, of approved pattern, on conduit passing through walls, floors and ceilings in finished areas. Where conduit passes through a sleeve, no point of the conduit shall touch the building construction. Caulk around such conduit with sufficient layers of two hour rated firesafing by Thermafiber 4.0 P.C.F. density, U.S.G. fire test 4/11/78 and seal off openings between conduit and sleeves with non-hardening mastic prior to application of escutcheon plate. Escutcheons shall be Gravler Sure-Lock, or approved equal.

2.6 SPACE LIMITATIONS

A. Equipment shall be chosen which shall properly fit into the physical space provided and shown on the drawings, allowing ample room for access, servicing, removal and replacement of parts, etc. Adequate space shall be allowed for clearances in accordance with Code requirements. Physical dimensions and arrangement of equipment shall be subject to the approval of the Architect.

2.7 PAINTING

A. All factory assembled equipment for electrical work, except light fixtures, that normally is delivered with a factory applied finish shall be delivered with a hard surface factory applied finish such as baked-on machinery enamel which will not require additional field painting. The finish shall consist of not less than 2 coats of medium gray color paint USA No. 61 Munsell Notation 8-3G, 6. 10/0.54 enamel. This Contractor shall protect this finish from damage due to construction operations until acceptance of the building. He shall be responsible for satisfactorily restoring any such finishes or replacing equipment that becomes stained or damaged.

2.8 ELECTRICAL SYSTEM IDENTIFICATION

A. Conduit Systems: Provide adequate marking of major conduit which is exposed or concealed in accessible spaces to distinguish each run as either a power or signal/communication conduit. Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Indicate voltage for that raceway. Locate markers at ends of conduit runs, on pull boxes, on junction boxes, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors, or enters non-accessible construction and at spacings of not more than 50 feet along each run of conduit. Switch-leg conduit and short branches for power connections do not have to be marked, except where conduit is larger than ¾ inch. Branch circuit conduits, junction boxes and pull boxes shall be marked with a permanent marker indicating panel name and branch circuit numbers.

B. Underground Cable Identification: Bury a continuous, preprinted, bright colored plastic ribbon cable marker with each underground cable (or group of cables), regardless of whether conductors are in conduit, duct bank, or direct buried. Locate each directly over cables, 6 to 8 inches below finished grade.

C. Identification of Equipment:

1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Care shall be taken not to obliterate this nameplate in any way.
2. Provide an additional laminated plastic engraved identifying nameplate for each major piece of equipment. Nameplates shall be Black backplate with white letters and numbers for Normal equipment. All labels shall be secured by stainless steel screws to each automatic transfer switch, switchboard, distribution panel, motor control center, panelboards, and safety disconnect switches.
   a. Identifying nameplates shall have ¼ inch high engraved letters and shall contain the following information:
      1) Name
      2) Voltage
      3) Phase
      4) "3" or "4" wire, and
      5) Where it is fed from.
   b. An example of a panelboard nameplate is:
      Center: **Panel – 1HB**
      Center: **480/277 volt, 3 phase, 4 wire**
      Center: **Fed from DP2**
   c. An example of an equipment disconnect switch nameplate is:
      Center: **AHU-1**
      Center: **480V, 3Ph**
      Center: **DP2-2,4,6**
   d. Transformer Nameplates shall be securely attached with rivets.
      Center: **T-CLA**
      Center: **480/208Y120V**
      Center: **Fed from HA-13,15,17**
3. Each feeder device in a switchboard, distribution panel, and motor control center device shall have a nameplate showing the load served in ½ inch high engraved letters.
4. Laminated plastic engraved identifying nameplate shall be secured by screws to each individual motor starter, enclosed circuit breaker, wireway, and terminal cabinet.
   a. Identifying nameplates shall have ¼ inch high engraved letters and shall indicate the equipment served.
   b. An example if an enclosed circuit breaker:
      Center: **Panel KH MCB**
5. Each wiring device in non-dwelling units shall be identified with the branch circuit (LA-2) using black on clear self-adhesive tape for normal loads. Affix labels to the front of the coverplate.
6. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a welded metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include location and name of each item of equipment served. Spares and spaces shall be written in erasable pencil for future use. Circuit directory shall show the room served by each circuit. The final graphs/signage room numbers shall be used. Do not use Architectural numbering on plans.
7. Prohibited Markings: Markings which are intended to identify the manufacturer, vendor, or other source from which the material has been obtained are prohibited for installation within public, tenant, or common areas within the project. Also, prohibited are materials or devices which bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters' Laboratories, Inc.), and approval labels are exceptions to this requirement.

8. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location; mount permanently in an appropriate and effective location. Comply with recognized industry standards for color and design.
9. Operational Tags: Where needed for proper and adequate information on operation and maintenance of electrical system, provide tags of plasticized card stock, either preprinted or hand printed. Tags shall convey the message, example: "DO NOT OPEN THIS SWITCH WHEN BURNER IS OPERATING."

PART 3 - EXECUTION

3.1 EXCAVATING AND BACKFILLING

A. Trenching and backfilling and other earthwork operations required to install the facilities specified herein shall conform to the applicable requirements of Division 2 (95% of maximum standard density). Where trenching or excavation is required in improved areas, the backfill shall be compacted to a condition equal to that of adjacent undisturbed earth and the surface of the area restored to the condition existing prior to trenching or excavating operations. Provide a minimum of 3" of sand underneath all conduits. The plans indicate information pertaining to surface and sub-surface obstructions; however, this information is not guaranteed. Should obstructions be encountered whether or not shown, the Contractor shall alter routing of new work, reroute existing lines, remove obstructions where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of new work and leave existing surfaces and structures in a satisfactory and serviceable condition. **All work shall comply with OSHA Standards.**

3.2 WORKMANSHIP AND CONCEALMENT

A. The work of this Section shall be performed by workman skilled in their trade. Installation shall be consistent in completeness whether concealed or exposed. Each item of electrical work shall be concealed in walls, chases, under floors and above ceilings except:

1. Where shown to be exposed.
2. Where exposure is necessary to the proper function.

3.3 SLEEVES, CUTTING AND PATCHING

A. This section shall be responsible for placing sleeves for all conduit passing through walls, partitions, sound walls, beams, floors, roof, etc. Sleeves through below-grade walls shall use water-tight fitting manufactured by O-Z/Gedney.

B. All cutting and patching will be done under another Division, but this Section will be responsible for timely performance of this work and layout of holes and setting sleeves.

C. All un-used sleeves shall be sealed with 2 hour UL approved fire sealant manufactured by "3M" or approved equal.

D. Refer to 26 05 33 for additional requirements.

3.4 ELECTRICAL GEAR

A. Install all electrical equipment in accordance with the National Electrical Code and as shown on the drawings.

B. Lighting contactors, time clocks, disconnect switches, etc. mounted in mechanical/electrical rooms shall be mounted at a working height not requiring a ladder, when wall space is available. Installation of these devices at greater elevations shall be approved by the Engineer. Contractor shall provide a coordination sketch of each mechanical/electrical room noting locations and mounting heights of all electrical devices (note bottom and top elevations) shown to be installed. Sketches shall be provided to the Engineer for review and the general contractor for coordination with other trades working in these rooms.

C. Fire retardant back boards secured to drywall studs may be used for contactors, time clocks, fire alarm equipment, security equipment, and disconnect switches 60 amp or smaller. All other wall mounted devices shall be mounted to unistrut. Unistrut shall be securely mounted to the floor and structural ceiling. Toggle bolts or anchor bolts attached to drywall is not acceptable.

3.06 CLEANING

A. Clean lighting fixtures and equipment.

B. Touch-up and refinish scratches and marred surfaces on panels, switches, starters, and transformers.

3.07 CORROSIVE AREAS

A. In areas of a corrosive nature, which include but are not limited to the following: pool equipment rooms, cooling towers and areas subject to salt air, etc., provide NEMA 4 X stainless steel or fiberglass reinforced enclosures for contactors, panelboards, controllers, starters, disconnects and materials used as supporting means (i.e. plastibond unistrut, pipe, fittings). The use of spray on coating may be acceptable in some applications.

3.08 TESTS AND INSPECTIONS

A. Tests and inspection requirements shall be coordinated with Division I.

B. Date for final acceptance test shall be sufficiently in advance of completion date of contract to permit alterations or adjustments necessary to achieve proper functioning of equipment prior to contract completion date.

C. Conduct re-tests as directed by Architect on portions of work or equipment altered or adjusted as determined to be necessary by final acceptance test. No resultant delay or consumption of time as a result of such necessary re-test beyond contract completion date shall relieve Contractor of his responsibility under contract.

D. Put circuits and equipment into service under normal conditions, collectively and separately, as may be required to determine satisfactory operation. Demonstrate equipment to operate in accordance with requirements of these specifications. Perform tests in the presence of Architect. Furnish instruments and personnel required for tests.

E. Final Inspection:

1. At the time designated by the Architect, the entire system shall be inspected by the Architect and Engineer. The contractor or his representative shall be present at this inspection.
2. Panelboards, switches, fixtures, etc., shall be cleaned and in operating condition.

3. Certificates and documents required hereinbefore shall be in order and presented to the Architect prior to inspection.
4. Panel covers, junction box covers, etc., shall be removed for visual inspection of the wire, bus bars, etc.
5. After the inspection, any items which are noted as needing to be changed or corrected in order to comply with these specifications and the drawings shall be accomplished without delay.

F. The contractor shall provide a thermographic test using an independent testing laboratory using an infrared scanning device. This test shall include but not limited to all switchboards, distribution panelboards, panelboards, automatic transfer switches and other electrical distribution devices. This test shall be conducted to locate high temperature levels. This test shall be conducted between 3 to 8 months after occupancy, but not beyond the one year warranty period. Submit test to the architect and engineer using test reporting forms. All unacceptable conditions shall be corrected prior to the end of the warranty period.

END OF SECTION

SECTION 26 05 19 - WIRE, CABLE AND RELATED MATERIALS

PART 1 - GENERAL

1.1 SCOPE

A. Provide 600 volt building wire, cable and connectors and 300 volt wire, cable and connectors.

B. WORK INCLUDED: Include the following Work in addition to items normally part of this Section.

1. Wiring for lighting and power.
2. Automatic Control Wiring.
3. Connection of equipment shown.

C. WORK SPECIFIED ELSEWHERE:

1. Heating, ventilating, and air conditioning equipment.
2. Structured cabling system.
3. Coaxial cables

1.2 STANDARDS

A. UL83

B. ASTM B-3

C. All wire cable and connectors shall be UL approved.

1.3 ACCEPTABLE MANUFACTURERS

A. 600 VOLT WIRE AND CABLE

1. Southwire
2. Encore
3. Cerro
4. General Cable

B. 300 VOLT WIRE AND CABLE

1. Westpenn
2. Beldon
3. Alpha
4. Southwire
5. General Cable

C. FLEXIBLE CABLE SYSTEMS

1. AFC Modular Cable Systems

D. CONNECTORS

1. Ilsco

2. Cooper
3. AMP - TYCO
4. Burndy
5. Ideal
6. 3M
7. NSI Industries
8. O.Z. Gedney
9. Thomas & Betts
10. Buchanan

1.4 SUBMITTALS

A. Shop drawings shall include, but not limited to:

1. Cutsheets of wire, cable and connectors to indicate the performance, fabrication procedures, product variations, and accessories.

1.5 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH:

A. National Electrical Code.

B. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 WIRING

A. All wire shall be new and continuous without weld, splice, or joints throughout its length. It must be uniform in cross-section, free from flaws, scales and other imperfections.

B. WIRE MATERIAL: Conductors shall be soft drawn, annealed copper. Aluminum wiring is not acceptable unless otherwise noted on drawings.

C. TYPES:

1. Provide type “THHN/THWN-2” insulation for all buried feeders and service entrance conductors.
2. Provide type “THHN/THWN-2” insulation for all branch circuits and above grade feeders.
3. All wire No. 8 and larger shall be stranded. All wire No. 10 and smaller shall be stranded or solid.
4. Provide type "XHHW" or other 90 degrees insulation wiring for branch circuit wiring installed through continuous rows of fixture bodies.
5. All 300-volt cable including but not limited to telephone, fire alarm, data, CATV and security shall be UL listed for use in return air plenums.

D. CONDUCTOR SIZES

1. Feeder conductors shall be sized for a maximum of 2% drop in rated voltage at scheduled load.
2. Branch circuit conductors shall be sized for a maximum 3% drop in the rated voltage to the longest outlet on the circuit.
3. Minimum wire shall be No. 12, unless otherwise shown on Drawings or required by Code.

E. COLOR CODING: No. 6 or larger conductors shall use tape for color coding. No. 8 and

smaller wire shall be color coded in accordance with the governing authority requirements or as follows:

120/208 VOLT	277/480 VOLT	120/240 VOLT
Neutral: White	Neutral: Gray	Neutral: White
Phase A: Black	Phase A: Purple	Phase A: Black
Phase B: Red	Phase B: Brown	Phase B: Orange
Phase C: Blue	Phase C: Yellow	Phase C: Blue
Ground: Green	Ground: Green	Ground: Green

2.2 GROUNDING

Permanently connect all conduit work, motors, starters, and other electrical equipment to grounding system in accordance with the National Electrical Code.

2.3 METAL CLAD CABLE - TYPE MC

At the contractor's option, metal clad cable (MC) may be used if approved by the authority having jurisdiction. The cable shall contain an insulated green grounding conductor (3 wire) and shall be the same size as the phase conductor. Conductors shall be solid copper and the armor shall be flexible galvanized steel. The Installer shall be certified by the AHJ for proper installation.

PART 3 - EXECUTION

3.1 WIRE

A. Do not pull wire into conduit until Work of an injurious nature is completed. Where two or more circuits run to a single outlet box, each circuit shall be properly tagged. Wyreze or approved equal may be used as a lubricant where necessary.

B. Splices shall be fully made up in outlet boxes with compression crimp-on type splice connectors.

C. Joints and splices will not be permitted in service entrance or in feeders. Joints in branch circuits will be permitted where branch circuits divide, and then shall consist of one through-circuit to which the branch shall be spliced. Joints shall not be left for the fixture hanger to make. Connect joints and splices with Buchanan Series "2000" solderless connectors complete with insulating caps or properly sized twist on wire nuts. "**Wago" push-in connectors are not acceptable.**

D. All stranded conductors shall be furnished with lugs or connectors.

E. Connectors furnished with circuit breakers or switches shall be suitable for copper wire termination.

F. "Sta-Cons" shall be used to terminate stranded conductors on all switches and receptacles.

G. Metal Clad Cable - Type MC

1. Metal clad cable shall not be used for homeruns. Metal clad cable shall only be used for branch circuit drops from ceiling mounted junction boxes to outlets and for horizontal runs in a common wall from outlet to outlet. Do not route to outlets

to adjacent walls. Metal clad cable may be looped from outlet to outlet in areas where non-accessible ceilings are used. Metal clad cable shall only be used in air-conditioned areas and shall not be run exposed.

2. Metal clad cable shall be UL approved connectors and shall be used and installed per Article 330 of the National Electrical Code. The cable shall be supported at intervals not exceeding 6 feet and within 12 inches of every box.
3. Provide anti-short bushing at cable ends.
4. Refer to electrical details for additional information and restrictions.
5. Metal clad cable shall not be installed in concrete.

H. All stranded #10 and small conductors shall be terminated with an approved solderless terminal if the device or light fixture does not have provisions for clamp type securing of the conductor.

I. The jacket for all travelers used on 3-way and 4-way switches shall be pink.

J. Route conductors for 480Y277V systems in a separate raceway. Do not combine with 208Y120V or 120/240V systems.

K. Emergency circuits shall not be routed with normal conductors.

3.2 BALANCING SYSTEM

The load on each distribution and lighting panel shall be balanced to within 10% by proper arrangement of branch circuits on the different phase legs. Provide written documentation showing results. Submit with O & M manuals.

3.3 LOW VOLTAGE WIRING

A. Low voltage wiring shall be plenum rated. All wiring in mechanical rooms, electrical rooms, drywall ceiling, inaccessible areas, underground, plaster ceiling, inside concealed walls areas exposed to occupant view, and other areas subject to physical damage shall be run in conduit.

B. Low voltage wiring shall be routed in separate raceways from power wiring systems.

C. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams, for the passage of wiring. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel.

D. Provide Caddy J-hooks supported independently from other system to support cable at 4-foot on center or closer if required by manufacture.

E. Provide a junction box to make up all joints and splices.

3.4 CABLE SUPPORTS

A. Provide cable supports in all vertical raceways in accordance with Article 300.19 of the NEC.

3.5 DEFECTS

A. Defects shall include, but are not to limited to, the following:

1. Tripping circuit breakers under normal operation.
2. Improperly connected equipment.
3. Damaged, torn, or skinned insulation.

END OF SECTION

SECTION 26 05 26 - GROUNDING

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Conditions and Supplementary Conditions apply to all work herein.

1.2 SCOPE

A. WORK COMBINED WITH OTHER SECTIONS: Combine the work specified herein with the following Sections to form a single responsibility for the Work:

1. Electrical.
2. Basic materials and methods.

B. Provide electrical service, equipment and wiring device grounding as shown, scheduled and as specified.

C. The types of grounding include, but not limited to, the grounding bonding of all equipment devices, building steel piping, and as required by the National Electrical Code, Local Inspection Department and Power Company.

1.3 STANDARDS

A. NATIONAL ELECTRICAL CODE (NFPA-70)

B. Local municipal and State codes that have jurisdiction.

C. NECA

1.4 ACCEPTABLE MANUFACTURES

A. Provide grounding products manufactured by Copperweld and Cadweld.

B. Burndy

1.5 SUBMITTALS

A. Shop drawings shall include, but not limited to the following:

1. Cut sheets of ground rods, clamps and connectors.
2. Grounding system diagram.

PART 2 - PRODUCTS

2.1 GENERAL: Provide all materials required to construct a complete grounded electrical system.

A. GROUND RODS: Ground rods shall be 3/4" inch diameter by 10 feet long construction with copper jacket and a steel core.

B. CLAMPS: Ground clamps shall be copper except for steel or iron pipes in which the clamps shall be galvanized iron.

C. CONDUCTORS: Conductors shall be connected by means of an approved pressure

connector or clamp.

D. EQUIPMENT GROUND BUS: Provide minimum 2” x 12” x ¼” copper ground bus bar, secured to wall in main electrical rooms and wherever noted at 12” AFF. Insulate from wall with stand-off bushings. Refer to Detail on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. GENERAL: Install grounding system as shown and specified to ensure a properly grounded system.

B. SERVICE ENTRANCE GROUNDING SYSTEM: Provide a main bonding jumper between the neutral and ground bus of each switchboard. Route a separate grounding electrode conductor in conduit from each main distribution panel to the ground rod grid, incoming cold water piping system. Provide a bonding jumper around water meter. The grounding electrode conductor shall be stranded copper, 98% conductivity and shall be run continuous without splices or joints and installed at least 12" below grade.

C. BUILDING STEEL AND PIPING SYSTEM: Install a bonding jumper between building steel and metallic piping systems to bond them to the electrical grounding system.

D. NEUTRAL: The neutral shall be grounded only at the service entrance and other separately derived systems. The neutral shall be kept separate from the grounding system and shall not be used as a ground.

E. GROUNDING SEPARATELY DERIVED ALTERNATING CURRENT SYSTEM

1. TRANSFORMERS: The center point (neutral) of each wye connected transformer shall be bonded to the case and the grounding electrode conductor shall be connected to the grounded conductor and building steel.

F. GROUNDING CONDUCTOR: A grounding conductor and metallic conduit system shall bond all equipment served by the electrical system. Provide a flexible bonding jumper for isolated metallic piping and ductwork and around expansion fittings and joints.

G. CONDUIT GROUNDING BUSHING: Conduit terminating in equipment that has a ground bus such as switchboards, panelboards, etc., shall have grounding bushings installed. Ground each conduit 1-1/4“, or larger by means of a grounding bushing and to the ground bus in the equipment.

H. MOTORS: The frame of all motors shall be grounded.

I. SPECIAL GROUNDING: Provide a minimum #6 AWG copper grounding conductor for each telephone board, television system, etc. unless otherwise noted. Terminate the grounding conductor on ground bus and to the building electrical grounding system. Refer to 800.100(D) and 820.100(D) of the NEC.

J. REMOTE PANELBOARDS: Provide a grounding electrode conductor to all remote panels as required by the NEC and shown on drawings.

K. LIGHTING FIXTURES: Flexible fixture whips containing a green grounding conductor shall be used to connect lighting fixtures. Flexible fixture whips shall not exceed ten feet. MC cable whips shall not exceed 6 feet.

L. RECEPTACLES: All receptacles shall be grounded using the branch circuit grounding conductor. Receptacles shall use an approved grounding yoke.

3.2 TESTING: Perform a ground resistance test using a biddle analog or digital portable earth/ground resistance tester. The system resistance shall not exceed 5 OHMS. Provide additional electrodes as required. Refer to 250.53(A) of the NEC. Test shall not be conducted following wet weather. Provide personal instruments to conduct these tests and submit certified test for review. Test shall be verified by Engineer.

END OF SECTION

SECTION 26 05 33 - RACEWAYS

PART 1 - GENERAL

1.1 SCOPE

A. Provide electrical raceways and fittings as shown, scheduled and specified.

B. The types of raceways and fittings required are as follows:

1. Rigid Metal Conduit (RMC)
2. Intermediate Metal Conduit (IMC)
3. Electrical metallic tubing (EMT)
4. Rigid Polyvinyl Chloride Conduit (PVC) (Sch. 40 or 80)
5. Flexible Metal Conduit (FMC)
6. PVC coated rigid galvanized steel conduit.
7. Aluminum Rigid Conduit (ARC)

1.2 STANDARDS

A. ANSI, C80.1 & C80.3

B. NEMA FB-1

C. NEMA TC3

D. UL, 6, 797 & 1242

1.3 ACCEPTABLE MANUFACTURERS

A. Raceways

1. Allied
2. Republic
3. Prime Conduit (Carlon)
4. Wheatland Tube
5. Cantex
6. Western Tube
7. Robroy Industries
8. OCAL

B. Fittings

1. Appleton
2. Crouse Hinds
3. Steel City
4. O.Z. Gedney
5. Carlon
6. Raco, Inc.
7. Bridgeport

C. Boxes

1. RACO

2. Thomas and Betts
3. Steel City
4. Eaton
5. Crouse-Hinds
6. Appleton

D. Surface Raceways

1. Hubbell
2. Wiremold
3. Panduit

1.4 SUBMITTALS

A. Shop drawing shall include but not be limited to:

1. Cutsheets for raceways and fitting, solvents, primers, etc.

1.5 REQUIREMENTS OF REGULATORY AGENCIES WORK IN ACCORDANCE WITH:

A. National Electrical Code.

B. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 CONDUIT AND FITTINGS:

a. Rigid Metal Conduit.

(1) Hot-dip galvanized rigid steel conduit, galvanized after fabrication. All threads shall be galvanized after cutting. A uniform zinc coating shall be applied to the inner and outer walls.

(2) Fittings shall be threaded, malleable iron, either cadmium plated or hot-dip galvanized.

b. PVC Coated Rigid Metal Conduit.

(1) Conduit shall be same as rigid metal conduit with a factory-applied 40-mil-thick covering of polyvinyl chloride (PVC) bonded to the exterior of the metal and a 2-mil urethane interior coating.]

(2) Fittings shall be the same as rigid metal conduit fittings with a factory-applied, 40-mil-thick covering of polyvinyl chloride (PVC) bonded to the exterior and a 2-mil urethane interior coating. All female threads shall be protected with urethane coating.

c. Intermediate Metal Conduit.

(1) Conduit shall be similar to rigid steel conduit except thinner wall.

(2) Fittings shall be threaded, malleable iron, either cadmium plated or hot-dip galvanized.

d. Electrical Metallic Tubing (EMT).

(1) EMT shall be made of hot-dip galvanized strip steel. The interior shall be coated with a corrosion-resistant lubricant for ease of wire pulling.

e. Rigid Nonmetallic Conduit.

(1) Conduit shall be schedule 40 or 80 polyvinyl chloride (PVC) or fiberglass, UV stabilized, rated for 90°C conductors.

(2) Fittings shall be solvent weld socket type.

f. Flexible Metal Conduit

(1) Spirally wound continuously interlocked zinc coated strip steel.

(2) Fittings shall be one screw for smaller than 1-1/2-inch, two screw for 1-1/2-inch and larger, double clamp steel or malleable iron, either cadmium plated or hot-dip galvanized.

2.2 PULL BOXES

A. Interior pull boxes shall be constructed of sheet metal. Covers shall be secured with screws and hinges where required.

B. Exterior in-ground pull boxes shall be concrete or polymer as manufactured by Brooks, Dalworth, Hubbell Quazite, or approved equivalent. Covers shall include identification of systems contained. Provide H20 wheel loading where in traffic bearing areas.

C. Pull boxes in pole bases shall be as manufactured by Carlon.

2.3 WIREWAYS

A. Wireways shall be made of not less than 16-gauge sheet steel for 4 inch and 6 inch square sizes and 14 gauge steel for 8 inch and 12 inch square sizes. Couplings end plates, and knockouts shall be furnished as required. Each section of wireways shall be rigidly supported.

B. The finish shall be ANSI-49 gray epoxy paint applied by a cathodic electrode position paint process over a corrosion resistant phosphate preparation for NEMA 1 wireways. Provide galvanized steel for NEMA 3R wireways. NEMA 3R wireways and auxiliary gutters are for horizontal mounting only.

2.4 FITTINGS

A. Couplings for rigid steel or intermediate conduit shall be hot dipped galvanized steel. Set screw type is not acceptable.

B. Steel or malleable iron fittings shall be used on all other raceway types except for PVC. Die-cast fittings are not allowed.

C. EMT systems shall utilize steel insulated throat, threadless, water tight compression type connectors and threadless steel water tight compression type couplings.

D. Coupling and connectors accessories and fittings for PVC coated rigid galvanized steel shall be PVC coated.

E. Liquid-tight Flexible Metal Conduit fittings shall be steel. Plastic is not acceptable.

F. Provide nylon bushing on end of all low voltage cabling system conduits (sleeves, rough-ins, etc.).

PART 3 - EXECUTION

3.1 PROVIDE CONDUIT AS FOLLOWS:

A. GENERAL

The Drawings are diagrammatic, and are intended to show the general location of outlets, devices, fixtures, and arrangement and control of circuits. The Contractor shall determine exact locations by actual measurement of the building or by reference to the Architectural Drawings.

B. Except as noted or otherwise specified, all wiring shall be installed in galvanized rigid steel or electrical metallic tubing (EMT) of the proper size to contain the number of conductors required in accordance with the latest edition of the N.E.C. Where conduit sizes are shown on the drawings, these shall take precedence.

C. EMT in sizes up to 4 inches when concealed or not exposed to damage and located indoors only. (EMT is not acceptable in wet and damp location.)

D. PVC coated rigid galvanized steel shall be used for all penetrations of slab on grade.

E. Rigid galvanized steel where embedded in concrete or masonry construction, mechanical yard or in exterior/interior applications where subject to damage.

F. Schedule 40 and 80 PVC may be utilized underground or below slab where shown on the construction documents. Conduit shall not be routed in slab unless specifically noted on the plans.

G. MINIMUM SIZE: 3/4 inch. All homeruns shall be 3/4" minimum. ½” conduit may be used for drops down walls to a single receptacle or switch.

H. PVC coated rigid galvanized steel conduit shall be coated inside and outside.

I. PVC coated rigid galvanized steel conduit shall be used at cooling towers, corrosive areas and pool pump rooms.

J. Fixture whips: Refer to 26 51 00 for additional information.

K. Flexible metal shall be used for connecting rotating equipment installed in conditioned dry locations spaces, unless noted otherwise, herein.

L. LFMC shall be used for connecting rotating or vibrating equipment installed in non-conditioned spaces or damp and wet locations, and outside.

N. Of such size, and so installed that conductors may be drawn in without injury or excessive strain.

O. Where entering panels, pull boxes, junction boxes, or outlet boxes, shall be secured in place with lock nuts inside and outside, and insulated bushings inside.

P. Have Red seal type VCC or approved equal cable supports in risers, as required by

N.E.C.

Q. Have ends reamed after cutting and application of die.

R. Keep conduit corked and dry during construction, and swab out before conductors are pulled.

S. Have bends and offsets made with approved tools. Bends or offsets in which the pipe is crushed or deformed shall not be installed.

T. Where not embedded in concrete or masonry, be firmly secured by approved clamps, half-straps or hangers.

U. Have O.Z. Gedney or approved equal expansion fittings where crossing building expansion joints.

V. Except in the mechanical equipment rooms, run conduit concealed, and by the shortest practicable route between outlets. Install risers, drops, and offsets necessary to avoid conflict with ductwork, piping, structural members, and similar items.

W. Install exposed conduit in mechanical rooms, and elsewhere as indicated, parallel to horizontal and vertical lines of walls, ceilings, and floors.

X. Lighting fixtures in finished areas having suspended acoustical ceilings shall be connected to outlet boxes of lighting grid by flexible metal conduit; length not to exceed eight feet (six feet if using 3/8” manufactured fixture “whips”).

Y. Outlet boxes in partitions shall never be set back to back. They shall be offset to prevent undue noise transmission from room to room.

Z. Concealed conduit shall run in as direct manner as possible using long bends. Exposed conduit shall be run parallel with or at right angles to the lines of the building; and all bends shall be made with standard conduit elbows or conduit benders. Not more than equivalent of four quarter bends shall be used in any run between terminals and cabinet, of between outlet or junction boxes. Approved condulets shall be used in lieu of conduit elbows where ease of installation and appearance warrants their use and approved by the engineer. Conduit joints shall be made with approved couplings and unions.

AA. Conduits shall be continuous from outlet to outlet and from outlets to cabinets, junction or pull boxes and shall be electrically continuous throughout. Terminals of all conduits shall be provided with double lock nuts and bushing or terminated on conduit hubs. Use of running threads is prohibited.

BB. Each entire conduit system shall be installed complete before any conductors are drawn in. Every run of conduit shall be finished before covering up to guard against obstructions and omissions.

CC. Sleeves shall be placed in the forms of concrete, masonry and fire rated walls, floor slabs and beams, for the passage of conduits. Sleeves should be set in place a sufficient time ahead of the concrete work so as not to delay the work. Sleeves shall be rigid galvanized steel and set to extend 4” above slab.

DD. All pipe penetrations through walls and concrete floors shall be fire rated by applying USG Thermafiber in the space between the concrete and the pipe. The fire rating shall be additionally sealed by using 3M brand model CP 25 or 303 fire barrier caulk and putty. All fire rating material shall be installed in accordance with manufacturer's printed

instructions.

EE. All conduit shall be cleaned and swabbed to remove all foreign matter and moisture prior to pulling wire and cable. All boxes in which conduits terminate shall be cleaned of all concrete mortar and other foreign matter.

FF. Provide #30 nylon pulling line in all conduits in which permanent wiring is not installed.

GG. All conduit shall be securely fastened and supported using hot galvanized malleable iron one-hole pipe straps, clamps, hanger or other means approved by the engineer. Supports shall be as required by NEC. Tie wire shall not be used as support or securing means. Support conduit independently of ceiling hanger wire. Use all thread rods to support outlet boxes, junction boxes and conduit.

HH. When PVC conduit is routed underground, all stub-up's and 90° elbows shall be PVC coated rigid galvanized steel. Use PVC coated rigid galvanized steel when penetrating concrete on grade. Wrap in plastic tape for entire length of pipe in contact with earth and concrete, to 6” above slab.

II. Branch circuits run underground shall be run in Schedule 40 or 80 PVC conduit. Install ground wire in accordance with NEC table 250.122.

JJ. Flexible and liquid-tight flexible steel conduit shall be used for final connections to utilization equipment. Liquid-tight flexible steel conduit shall be used for all exterior locations and all interior locations subject to moisture, vibrations, rotating equipment and dry-type transformers. Refer to Section 26 02 00 for additional information concerning flexible steel conduit.

KK. Contact the Architect and Engineer for an installation review before covering any below grade or above grade conduit.

LL. All new outlets shall be flush mounted. In remodeled areas where wall construction prohibits flush mounting, provide wiremold 2400 series, unless noted otherwise. Verify exact location and routing with architect before installation.

MM. Contractor shall not penetrate water proof barriers without using proper fitting to maintain barriers. This shall include exterior walls and slabs. Coordinate with Architect for proper methods.

3.2 CONDUIT CORROSION PROTECTION

A. Branch circuit conduits installed in concrete slabs on fill or grade shall be positioned in a manner to ensure complete concrete cover. In no case shall such conduits be exposed below or above the slab surfaces, or penetrate the waterproof membrane.

B. At locations where metallic conduits pass through slabs on grade or transitions below grade, PVC coated rigid galvanized conduit shall be used.

C. Conduit installed in the air gap between the water resistant barrier and finish brick shall not exceed 2ft in length.

3.3 EXPANSION FITTINGS

A. Install approved expansion fitting in all conduit runs in excess of 150 feet or when crossing building expansion joints.

B. Make provision for expansion and shifting of metal or PVC conduits where risers occur from underground.

3.4 OUTLET AND JUNCTION BOXES

A. Provide an approved galvanized outlet box with adequate volume for number of conductors installed.

B. Provide standard galvanized switch boxes of the required number of gangs. Switch boxes where conduit is exposed shall be handy boxes or approved equal.

C. Outlet boxes for receptacles shall be similar to Universal 52151 with suitable raised cover. Receptacle boxes where conduit is exposed shall be handy boxes or approved equal.

D. Weatherproof boxes shall be FS or FD. Provide these boxes in all non-conditioned areas, exterior areas and natatoriums.

E. Outdoor boxes shall be NEMA 3R, with conduit connections made by Myers Hubs.

F. See notes and details on Drawings for special box requirements.

G. Provide junction boxes required to facilitate installation of the various conduit systems. Provide support boxes required for risers, each complete with approved cable supports as described elsewhere in this Division.

H. Outlet boxes for drywall shall be standard galvanized 4" square boxes with the appropriate device cover. Secure all outlet boxes with a backing brace connected to two adjacent studs. Mounting brackets with a single ear to rest against the backing sheetrock are not acceptable.

I. Provide floor outlet fittings for voice/data requirements to match fittings for duplex floor receptacles.

J. Provide 3-1/2” deep gangable masonry boxes in all masonry wall (CMU). Steel City GW-135-G or approved equal.

K. Provide shallow 4”x4” boxes in all demountable partitions.

L. Metallic boxes located in fire rated walls or partitions shall be separated by a minimum horizontal distance of 24 in. This minimum separation distance between metallic boxes may be reduced when “ Wall Opening Protective Materials” (CLIV) are installed according to the requirements of their Classification. Metallic boxes shall not be installed on opposite side of walls or partitions of staggered stud construction unless “Wall Opening Protective Materials” are installed with the metallic boxes in accordance with Classification requirements for the protective materials.

M. Junction, pull boxes, condulets, gutters, disconnects, contactors, etc., above 2-foot x 2-foot grid ceilings shall be mounted within 18-inches of ceiling grid. Above 2-foot x 4 – foot grid ceiling they shall be mounted within 30-inches of ceiling grid. All junction box, pull box, gutter openings shall be side or bottom accessible.

3.5 THRU-WALL SEALS

A. Provide O.Z. Gedney “Thru-wall” seals for all conduits passing through concrete structure below grade, above grade, and floor penetrations below grade. These prevent moisture

from entering the building.

B. Straight sleeves are not acceptable.

3.6 PULL BOXES

A. Interior pull boxes shall be provided for conduit systems as required and shall be constructed of galvanized steel of not less than gauge and size specified by National Electrical Code. Size pull boxes per NEC 314.28, minimum.

B. Where two or more feeders pass through a common pull box, they shall be tagged to indicate clearly their electrical characteristics, circuit number, and panel designation.

C. Exterior in-ground pull boxes shall have open bottoms with sand and rock beds below box for drainage of water. Provide closed bottom boxes where specified. Closed bottom boxes shall be provided with sumps for portable pump to allow for extracting water. Refer to details on the drawings.

D. Pull boxes mounted in pole bases shall be coordinated with the pour of the pole base and shall be flush with finished footing.

3.7 WIREWAYS

A. Wireways shall be installed as indicated or required and locations shall be coordinated with architect.

B. Wiring in wireways shall be neatly bundled, tied and suitably tagged.

3.8 UNDERGROUND DUCTBANK SYSTEM

A. DUCT SYSTEM

1. The duct system shall consist of Schedule 80 PVC conduits encased in concrete as detailed on the drawings. Use rigid conduit for stub-ups and the last ten feet at the end of each ductbank. Duct lines shall be laid to a minimum grade of 4 inches per 100 feet and shall be free from either horizontal or vertical waves. Duct lines shall be straight unless otherwise noted on the drawings. Duct lines shall be installed so that the top of concrete in encased duct lines is not less than 24 inches below finished grade or finished paving at any point. Changes in direction or runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 5 feet. The long sweep bends may be made up of one or more curved or straight sections and/or combinations thereof using five degree angle couplings. Conduit shall be thoroughly cleaned before using or laying. During construction and after the duct line is completed, the ends of the conduit shall be plugged to prevent water washing mud into the conduits. Particular care shall be taken to keep the conduits clean of concrete, dirt, and any other substance during the course of construction.
2. Each single conduit of the duct bank shall be completely encased in steel reinforced concrete as indicated. The thickness of concrete encasement indicated is the minimum thickness, and may be increased to fit the actual shape of trench.
    a. Envelopes may be poured directly against sides of trenches if the "cut" is clean, even and free of loose material. All loose dirt and extraneous material shall be removed from the trenches before and during the pouring of concrete to ensure sound envelopes. Concrete shall be

carefully spaded during pouring to eliminate all voids under and between the conduit and honeycombing of the exterior surfaces. Power driven tampers of agitators shall not be used, unless specifically designed for the application, in order to ensure that the water-tightness of the conduits is not destroyed.

b. Generally, each run of envelopes shall be poured in one continuous operation. Where more than one pour is necessary, each pour shall terminate in a vertical plane. Partial pours shall not terminate in horizontal or angular planes.

B. For normal underground installation see Section 26 02 00, paragraph 3.01 for Excavating and Backfilling.

END OF SECTION

SECTION 26 09 43.13 – DIGITAL LIGHTING CONTROLS

PART 1 – GENERAL

1.1 SCOPE

Electrical contractor shall provide and install a complete networked lighting control system that controls all interior and exterior lighting fixtures, including emergency fixtures. All lighting fixtures shall be controllable from the district energy management office. It is the contractor's responsibility to provide and install a complete and functional system, including, but not limited to all room controllers, occupancy sensors, low voltage control stations, emergency bypass controllers, and relay panels, low voltage control cable and lighting network equipment, even if not specifically called out on the plans.

1.2 SUMMARY

A. Section Includes:
   1. Digital Occupancy and Daylighting Sensor Control
   2. Emergency Lighting Control

B. Related Section
   1. Section 26 27 26 - Wiring Devices: Receptacles
   2. Section 26 51 00 13 – Interior Lighting Fixtures, and Drivers:
   3. Drawings and general provision of the Contact, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section
   4. Electrical Sections, including wiring devices, apply to the work of this Section.

C. Control Intent – Control Intent includes, but is not limited to:
   1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
   2. Initial sensor and switching zones
   3. Initial time switch settings

1.3 REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)

B. Underwriter Laboratories of Canada (ULC)

C. International Electrotechnical Commission

D. International Organization for Standardization (ISO)

E. National Electrical Manufacturers Association (NEMA)

F. WD1 (R2005) - General Color Requirements for Wiring Devices.

G. Underwriters Laboratories, Inc. (UL)
   1. 916 – Energy Management Equipment.
   2. 924 – Emergency Lighting

1.4 SYSTEM DESCRIPTION & OPERATION

A. The Lighting Control and Automation system as defined under this section covers the following equipment:
   1. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
   2. Digital Switches – Self-configuring, digitally addressable pushbutton switches, dimmers, and scene switches with two-way active infrared (IR) communications.
   3. Digital Photosensors – Single-zone closed loop and multi-zone open loop daylighting sensors with two-way active infrared (IR) communications can provide switching or dimming control for daylight harvesting.

1.5 SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.

B. Shop Drawings:
   1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed (standard diagrams will not be accepted).
   2. Scale drawing for each area showing exact location of each sensor, room controller, and digital switch.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Include data for each device which:
   1. Indicates where sensor is proposed to be installed.
   2. Prove that the sensor is suitable for the proposed application.

1.6 QUALITY ASSURANCE

A. Manufacturer: Minimum 10 years experience in manufacture of lighting controls.

1.7 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   1. Ambient temperature: 0° to 40° C (32° to 104° F).
   2. Relative humidity: Maximum 90 percent, non-condensing.

1.8 WARRANTY

A. Provide a five year complete manufacturer's warranty on all products to be free of manufacturers' defects.

1.9 MAINTENANCE

A. Spare Parts:
   1. Provide 1 spare LMSM-6E. Provide 5 spares of each product listed below to be used for maintenance. Electrical contractor deliver items to SISD maintenance within 30 days of substantial completion.
      a. Room Controllers

b. Occupancy Sensors
c. Emergency Bypass controllers
d. Low voltage switches
e. Daylighting harvesting photocells

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:
WattStopper: (No substitutions)
Representative: CW lighting at 713-690-9320

2.2 WALL SWITCH OCCUPANCY SENSORS

A. Type DW: Manual-ON, Automatic-OFF dual technology (passive infrared and ultrasonic) wall switch occupancy sensor. Provide the model which suits the electrical system parameters, and accommodates the square-foot coverage and wattage requirement for each area (and type of lighting) controlled. WattStopper LMDW-101 or LMDW-102

2.3 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

A. Ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Provide the system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters. Passive infrared only sensors shall not be used for classroom applications.

B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:

1. Digital calibration and pushbutton programming for the following variables:
   a. Sensitivity – 0-100% in 10% increments
   b. Time delay – 1-30 minutes in 1 minute increments
   c. Test mode – Five second time delay
   d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
   e. Walk-through mode
   f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
2. One or two RJ-45 port(s) for connection to DLM local network.
3. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
4. Device Status LEDs including:
   a. PIR Detection
   b. Ultrasonic detection
   c. Configuration mode
   d. Load binding
5. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
6. Manual override of controlled loads.

C. Units shall not have any dip switches or potentiometers for field settings.

D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

E. All devices shall be hard wired. No wireless devices shall be permitted.

F. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.4 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration; available in white, light almond, ivory, grey and black; compatible with wall plates with decorator opening. Wall switches shall include the following features:

1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
3. Red configuration LED on each switch that blinks to indicate data transmission.
4. Blue Load/Scene Status LED on each switch button with the following characteristics:
   a. Bi-level LED
   b. Dim locator level indicates power to switch
   c. Bright status level indicates that load or scene is active
5. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.

B. Two RJ-45 ports for connection to DLM local network.

C. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.

D. The following switch attributes may be changed or selected using a wireless configuration tool:

1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
2. Individual button function may be configured to Toggle, On only or Off only.
3. Individual scenes may be locked to prevent unauthorized change.
4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
5. Ramp rate may be adjusted for each dimmer switch.
6. Switch buttons may be bound to any load on a room controller and are not load type dependent and each button may be bound to multiple loads.

E. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101.

2.5 DIGITAL PHOTOSENSORS

A. Digital photosensors work with room controllers to provide automatic switching or dimming daylight harvesting capabilities for any load type connected to a room controller. Closed loop photosensors measure the ambient light in the space and control

a single lighting zone. Open loop photosensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones. Photosensors shall be interchangeable without the need for rewiring.

B. Digital photosensors include the following features:

1. An internal photodiode that measures only within the visible spectrum, and has a response curve that closely matches the photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-10,000 footcandles (fc).
3. The capability of switching one-third, one-half or all lighting ON and OFF, or raising or lowering lighting levels, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
4. For switching daylight harvesting, the photosensor shall provide a deadband or a separation between the “ON Setpoint” and the “OFF Setpoint” that will prevent the lights from cycling after they turn off.
5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a user-selectable minimum level.
6. Optional programmable wall switch override to allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise and lower lighting levels for a selected period of time or cycle of occupancy.
7. Infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
8. Red configuration LED that blinks to indicate data transmission.
9. Blue status LED indicates test mode, override mode and load binding.
10. Recessed switch to turn controlled load(s) ON and OFF.
11. One RJ-45 port for connection to DLM local network.
12. An adjustable head and a mounting bracket to accommodate multiple mounting methods and building materials. The photosensor may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox.

C. Closed loop digital photosensors include the following additional features:

1. An internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from bright sources outside of this cone.
2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
3. Automatically establishes setpoints following self-calibration.
4. A sliding setpoint control algorithm for dimming daylight harvesting with a “Day Setpoint” and the “Night Setpoint” to prevent the lights from cycling.
5. WattStopper Product Number: LMLS-400.

D. Open loop digital photosensors include the following additional features:

1. An internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
2. Automatically establishes setpoints following calibration using a wireless configuration tool or a PC with appropriate software.
3. A proportional control algorithm for dimming daylight harvesting with a “Setpoint” to be maintained during operation.

4. WattStopper Product Number: LMLS-500.

2.6 CONFIGURATIONS TOOLS

A. A configuration tool facilitates optional customization of DLM local networks, and is used to set up open loop daylighting sensors. A wireless configuration tool features infrared communications, while PC software connects to each local network via a USB interface.

B. Features and functionality of the wireless configuration tool shall include:

1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
2. High visibility organic LED (OLED) display, pushbutton user interface and menu- driven operation.
3. Read, modify and send parameters for occupancy sensors, daylighting sensors, room controllers and buttons on digital wall switches.
4. Save up to nine occupancy sensor setting profiles, and apply profiles to selected sensors.
5. Temporarily adjust light level of any load(s)on the local network, and incorporate those levels in scene setting.
6. Adjust or fine-tune daylighting settings established during auto-commissioning, and input light level data to complete commissioning of open loop daylighting controls.

C. WattStopper Product Numbers: LMCT-100, LMCI-100/LMCS-100

2.7 SEGMENT MANAGER

A. The Digital Lighting Management system shall include at least one segment manager to manage network communication. It shall serve up a graphical user interface via a standard web browser. Each segment manager shall have support for one, two or three segment networks as required and allow for control of a maximum of 40 local networks (rooms) and/or lighting control panels per segment network.

B. Operational features of the Segment Manager shall include the following:

1. Connection to PC or LAN via standard Ethernet TCP/IP.
2. Easy to learn and use graphical user interface, compatible with Internet Explorer 8, or equal browser.
3. Log in security capable of restricting some users to view-only or other limited operations.
4. Automatic discovery of all DLM devices on the segment network(s). Commissioning beyond activation of the discovery function shall not be required.
5. After discovery, all rooms and panels shall be presented in a standard navigation tree format. Selecting a device from the tree will allow the device settings and operational parameters to be viewed and changed by the user.
6. Ability to view and modify room device operational parameters. It shall be possible to set device parameters independently for normal hours and after hours operation.
7. Ability to set up schedules for rooms and panels. Schedules shall automatically set controlled zones or areas to either a normal hours or after hours mode of operation.
8. Ability to group rooms and loads for common control by schedules, switches or network commands.

9. Ability to monitor connected load current and display power consumption for areas equipped with room controllers incorporating the integral current monitoring feature.
10. Provide seamless integration with the BAS via BACnet IP. Provide export table with available parameters.

C. WattStopper Product Numbers: LMSM-6E.

PART 4 – EXECUTION

4.1 INSTALLATION

A. Contractor shall provide to the manufacturer all quantities for system including but not limited to relays, room controllers, relay panels, plug load controllers, switches, sensors and wire lengths and configurations for both network and device cable at least 1 week before bid.

B. When using wire for connections other than the DLM local network (Cat 5e with RJ-45 connectors), provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements

C. All MSTP network and Cat 5e low voltage wiring must have “WattStopper” printed on the wire jacket. Any cable substitutions shall be removed and replaced at the contractor’s expense.

D. All MSTP network terminations shall utilize wire ferrules for terminations and MSTP network manufacturer’s instructions. Any network deficiencies shall be repaired at the contractor’s expense.

E. Electrical contractor must provide a detailed as-built plan in CAD showing MSTP network cable routing and network bridge serial numbers to the manufacturer at least 2 weeks prior to factory commissioning Install the work of this Section in accordance with manufacturer’s printed instructions unless otherwise indicated.

4.2 FACTORY COMMISSIONING

A. Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.

B. The factory commissioning shall include the following services. Programming of all button stations, configuration of all occupancy sensors and photocells. Verification of a complete and working system including MSTP network status. Provide written or computer-generated documentation on the commissioning of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
3. Load Parameters (e.g. blink warning, etc.)

C. The electrical contractor shall request factory commissioning by submitting a startup request form at least (4) weeks before startup is required.

D. The electrical contractor shall provide at least (1) journeyman electrician, familiar with the installation of the system, dedicated to assisting the factory start-up technician for

the entire duration of the commissioning process.

E. Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

F. Provide a training session for the owner’s operations personnel. Training session shall be performed by a qualified person who is knowledgeable in the subject/equipment. Submit a training agenda two (2) weeks prior to the proposed training session for review and approval. Training session shall include at the minimum:

1. Purpose of equipment.
2. Principle of how the equipment works.
3. Important parts and assemblies.
4. How the equipment achieves its purpose and necessary operating conditions.
5. Most likely failure modes, causes and corrections.
6. On site demonstration.

4.3 Re-commissioning – After 90 days from occupancy the factory authorized representative and electrical contractor shall re-calibrate all sensor time delays and sensitivities to meet the Owner’s Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity

END OF SECTION

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE

A. Provide panelboards as shown, scheduled and as specified herein.

B. The types of panelboards include:

1. Panelboards.
2. Power distribution panelboards.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable standards.

B. Products shall conform to all applicable UL standards and shall be UL-labeled.

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:

1. General Electric Company/ABB
2. Square D Company
3. Siemens
4. Eaton

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:

1. Cutsheets of all enclosures, circuit breakers, fusible switches, bussing, rating, schedules and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:

1. National Electrical Code.
2. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General

Provide power distribution and panelboards as indicated in the panelboard schedule and as shown on the plans. Power distribution panelboards shall be equipped with fusible switches or circuit breakers as shown on the schedule. Panelboards shall be equipped with thermal-magnetic, molded case circuit breakers of frame and trip ratings as shown on the schedule.

B. Busing Assembly and Temperature Rise

Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50ºC. rise above 40ºC ambient. Heat rise test shall be conducted in accordance with Underwriters Laboratories Standard UL 67. The use of conductor dimensions will not be accepted in lieu of actual heat tests. All current carrying parts of the bus shall be tin or silver-plated copper.

1. Bus structure shall be isolated. Bus bar connections to the branch circuit breakers shall be distributed phase or phase sequence type and shall accept bolt-on circuit breakers for all panelboards.

2. The lugs for terminating conductors shall be rated at 75° C on all panel boards and circuit breakers.

Provide an extruded bare copper ground bus. Provide an isolated ground copper bus in each panel serving isolated ground circuits. Provide a full-size copper neutral bus in each panelboard enclosure. Provide a double size neutral buss when served by a harmonic mitigating transformer.

C. Distribution Panelboards

Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position. Tripped indication shall be clearly shown by the breaker handle taking a position between “ON” and “OFF”. Provisions for additional breakers shall be such that no additional connectors will be required to add breakers. Circuit breakers shall be of the frame size, trip setting and interrupting capacity as indicated on the drawings. Circuit breakers shall be rated 65,000 AIC unless otherwise noted on plans.

1. Provide arc energy reduction switch for each breaker rated 1200 amps or larger to comply with 240.87 of the NEC. Switch shall be equipped with a pad lockable cover with a blue LED pilot light that illuminates when system is activated. Locate switch and cover recessed mounted adjacent to the breaker it serves or remote as indicated on the plans. Provide label and all required hardware. Remote switch(es) shall be flush mounted in wall near entry to the room or where indicated.

D. 480/277 Volt Panelboards

Main breakers shall be vertically mounted. Horizontally mounted main breakers are not acceptable.

Circuit breakers shall be bolt-on thermal-magnetic, molded case circuit breakers. Breakers shall be 1, 2 or 3-pole with an integral crossbar to assure simultaneous opening of all poles in multiple circuit breakers. Breaker shall have an over-center, trip-free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication. Handles shall have “ON”, “OFF” and “TRIPPED” positions. Circuit breakers shall be UL listed in accordance with UL Standard 489 and shall be rated 277 Volt ac (single pole, 15-30 amperes) or 480Y/277 volts ac (2 and 3 pole) with continuous current ratings as noted on the plan. Interrupting ratings shall be a minimum of 18,000 rms symmetrical amperes at 277 volts ac (single pole) or 480Y/277 volts ac (2 and 3 pole). Single pole, 15 and 20 ampere circuit breakers intended to switch fluorescent lighting loads on a regular basis shall carry the SWD marking. Circuit breakers shall be rated 18,000 AIC unless otherwise noted on plans.

E. 240 Volt Panelboards

Main breakers shall be vertically mounted. Horizontally mounted main breakers are not acceptable.

Circuit breakers shall be bolt-on thermal-magnetic, molded case circuit breakers. Breakers shall be 1, 2, or 3 pole with an integral crossbar to assure simultaneous opening of all poles in multiple circuit breakers. Breakers shall have an overcenter, trip-free, toggle-type operating mechanism with quick-make, quick-break action and positive handle indication. Handles shall have "ON", "OFF" and "TRIPPED" positions.

Circuit breakers shall be UL listed in accordance with UL standard 489 and shall be rated 240 volts ac maximum with continuous current rating as noted on the plans.

Branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip settings of not more than 10 times the trip settings of the breaker to prevent repeated arcing short resulting from frayed appliance cords. Single pole 15 and 20 ampere circuit breakers shall be UL listed as "Switching Breakers" at 120V ac and carry the SWD marking.

UL Class A 5mA ground fault circuit protection shall be provided on all receptacle circuits serving wet areas and on all 120V ac branch circuits as specified on the plans or panelboard schedule. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. A single pole circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than a conventional circuit breaker.

UL Class B 30mA ground fault circuit protection (GFEP) shall be provided on all equipment circuits requiring ground fault protection. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring.

Provide Breaker with Switched Neutral circuits with common trip for gasoline pumps and other equipment having this requirement.

Circuit breakers shall be rated 22,000 AIC unless otherwise noted on plans.

Provide double sized neutral bus with panels served from a non-linear transformer or when indicated on drawings. This shall be a UL approved assembly.

F. Cabinets and Fronts

The panelboard bus assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. Wiring gutter space shall be in accordance with UL Standard 67 for panelboards. The box shall be fabricated from galvanized steel or equivalent rust resistant steel. Provide stainless steel front cover for all panels located in all Pool Equipment rooms. All NEMA-1 panels shall have hinged front covers. The front cover shall have a door with hinges, latch and a lock. The piano hinged, door-in-door front covers shall allow full access to the circuit breaker gutter area without having to remove the entire front cover. All panelboard lock shall be keyed alike. Circuit breaker and fusible distribution panels shall have four-piece trims. A welded circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. Provide NEMA 1 enclosure where installed indoors unless otherwise noted. Provide NEMA 3R enclosure where installed outside or in a sprinkled area.

G. Safety Barrier

The distribution panelboard interior assembly shall be dead front with panelboard cover removed. Main lugs or main breakers shall have barriers on five sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

H. Integrated Equipment Short Circuit Rating

Each panelboard, as a complete unit, shall have a short circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or on the plans. This rating shall be established by testing with the over-current devices mounted in the panelboard. The short circuit tests on the over-current devices and on the panelboard structure shall be made simultaneously by connecting the fault to each over-current device with the panelboard connected to its rated voltage source. Method of testing shall be per Underwriters Laboratories Standard UL 67. The source shall be capable of supplying the specified panelboard short circuit current or greater. Testing of panelboard over-current devices for short circuit rating only while individually mounted is not acceptable. Also, testing of the bus structure alone is not acceptable. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage and shall be UL listed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install panelboards, including electrical connections, in accordance with manufacturers written instructions, NEC and recognized industry practices.

B. Housekeeping Pads: Mount floor mounted panelboards on 4-inch high concrete housekeeping pads.

C. Fuses: Install fuses of the rating and class as shown in each fusible distribution panel scheduled on drawings.

D. Conduits: Stub up three one-inch conduits to an accessible location above the ceiling for each recessed panelboard.

E. Infrared Scanning: After Substantial Completion by not more than 2 months after Final Acceptance, perform an infrared scan of each switchboard. Remove fronts if not equipped with viewing ports to make joints and connections accessible to a portable scanner. Submit a copy the owner and engineer for review. If O&M manuals are submitted prior to performance of infrared scan, contractor shall submit a signed letter to verify the scan has been arranged. Letter shall indicate the scan provider and the date It will be performed.]

3.2 IDENTIFICATION

A. Nameplate: Each panelboard shall have an engraved bakelite nameplate. Nameplates shall be white with black letters and show panel designation. Nameplates shall be attached with stainless steel screws. Refer to Section 26 02 00, paragraph 2.08(C).

B. Directory Card: Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include location and name of each item of equipment served. Spares and spaces shall be written in erasable pencil for future use. Circuit directory shall show

the room served by each circuit. The final graphs/signage room numbers shall be used. Do not use Architectural numbering on plans.

C. Replacement Components: Nameplate shall identify replacement components.

END OF SECTION

SECTION 26 28 16 - SAFETY AND DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 SCOPE

A. Provide safety and disconnect switches as shown, scheduled and as specified herein.
B. Refer to Section 26 29 01 for motor rated toggle type starter/disconnect switches.

1.2 STANDARDS

A. Products shall be designed, manufactured, tested and installed in compliance with applicable standards.

1. NEMA KS1 - Enclosed switches
2. Federal specification W-S-865C-Heavy duty switches

B. Products shall conform all applicable UL standards, including UL98 (standard for safety, enclosed and dead front switches) and shall be UL-labeled.

1.3 ACCEPTABLE MANUFACTURERS

A. Provide one of the following manufacturers:

1. General Electric Company
2. Square D Company
3. Siemens
4. Eaton

1.4 SUBMITTALS

A. Shop drawings shall include, but not be limited to:

1. Cutsheets of switches with ratings, physical dimensions and all accessories clearly labeled.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:

1. National Electrical Code.
2. Local, municipal, or state codes that have jurisdiction.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install heavy duty type safety switches with the number of switched poles as indicated on the plans and specifications. All safety switches shall be NEMA Heavy Duty Type HD, and Underwriters Laboratories listed.

2.2 MATERIALS AND COMPONENTS

A. Switch Interior

All switches shall have switch blades that are fully visible in the "OFF" position when the

door is open. Switches shall have removable arc suppressor where necessary, to permit easy access to line side lugs. Lugs shall be front removable and UL listed for 60ºC and 75ºC copper or aluminum cables. All switches blades and contacts shall be plated copper. Adjust fuse block to accept Class J fuses, as required.

B. Switch Mechanism

Switches shall have a quick-make and quick-break operating handle and mechanism, which shall be an integral part of the box, not the cover. Padlocking provisions shall be provided for locking in the "OFF" position with at least three padlocks. Switches shall have a dual cover interlock to prevent unauthorized opening of the switch door when the handle is in the "ON" position, and to prevent closing of the switch mechanism with the door open. A means shall be provided to permit authorized personnel to release the interlock for inspection purposes. Handle position shall indicate if switch is "ON" or "OFF".

C. Neutral

Provide a solid neutral with the safety switch where a neutral is present in the circuit.

D. Ratings

Switches shall be horsepower rated for ac and/or dc as indicated by the plans. The fused switches shall have Class R rejection fuse clips or adjusted for Class J fuses. UL listed short circuit ratings of the switches, when equipped with Class R fuses, shall be 200,000 symmetrical amperes.

E. Enclosures

1. Indoor switches shall be furnished in NEMA 1 enclosures.
2. Outdoor switches, switches located in wet areas or sprinkled areas shall be furnished in NEMA 3R enclosures.
3. Switches installed in areas of a corrosive nature and subjected to salt air shall be NEMA 4X stainless steel or fiberglass reinforced polyester.

F. Electrical Interlock Contacts

Provide electrical interlock contacts on all disconnect switches serving motors in which remote VFDs are serving the motor. Provide conductors from contacts to the safe circuit inside the VFD. De-energizing the disconnect switch shall signal VFD to stop.

G. Service Entrance

Switch shall be suitable for use as service entrance equipment when installed in accordance with the National Electrical Code.

H. Grounding

Provide a grounding bar with each safety switch.

PART 3 - EXECUTION

3.1 GENERAL

A. Install safety and disconnect switches, including electrical connections, and fuses in accordance with manufacturer's written instructions, NEC and recognized industry practices.

B. Location: Install switches within sight of controllers.

C. Hubs: Provide bolt-on hubs for rainproof or wet area applications.

D. Infrared Scanning: After Substantial Completion by not more than 2 months after Final Acceptance, perform an infrared scan of each switchboard. Remove fronts if not equipped with viewing ports to make joints and connections accessible to a portable scanner.

3.2 IDENTIFICATION

A. Nameplate: Each disconnect switch shall have an engraved bakelite nameplate. Nameplates shall be white with black letters and show equipment served. Nameplates shall be attached with stainless steel screws.

END OF SECTION

SECTION 26 51 00 - LIGHTING FIXTURES

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install general and emergency lighting fixtures as noted on the drawings. Fixtures shall be completely wired with lamps installed and shall be in perfect operating condition at the time of substantial completion.

B. The types of lighting fixtures required for this project include:

1. LED

C. RELATED WORK SPECIFIED ELSEWHERE:

1. Div. 26 Wiring Devices
2. Div. 26 Miscellaneous Electrical Controls and Wiring

1.2 STANDARDS

A. All fixtures shall conform to all applicable UL standards and shall be UL listed and labeled including damp and wet location ratings. “ETL Listed” is an acceptable listing and other NRTL listings may or may not be acceptable.

B. All fluorescent ballast shall comply with certified ballast manufacture (CBM) standard and CBM labeled.

C. NFPA 101

D. ANSI C82.1

E. NEMA-LE

F. IEEE Publication 587 Category "A" (Electronic Ballast)

G. All LED drivers shall be UL recognized Class 2 per UL1310 or non-Class 2 per UL 1012 as applicable.

H. All LED drivers shall comply with applicable requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 15, for Non-Consumer Equipment.

I. All LED drivers shall be RoHS compliant.

J. TM-21

K. LM-80

L. LM-79

M. L70

N. DLC

1.3 ACCEPTABLE MANUFACTURERS

A. Provide lighting fixtures produced by manufacturers as shown and scheduled.

B. LED DRIVER:

1. Provide one of the following manufacturers
   a. Eldo
   b. Lutron
   c. Osram
   d. Philips

C. LAMPS:

1. Provide one of the following manufacturers
   a. General Electric Company
   b. Osram Sylvania
   c. North American Philips

2. Provide one of the following LED Chip manufacturers
   a. Cree
   b. Nichia
   c. North American Philips

1.4 SUBMITTALS

A. Shop drawings shall include a brochure with a separate cut sheet for each fixture type arranged in alphabetical order with fixture and all accessories/options clearly labeled. Provide performance data for each fixture. Provide an independent test lab report for each fixture if requested by the Architect/Engineer.

B. Provide ballast and lamp data brochures indicating which lamp and ballast (if required) will be used in each fixture type.

C. Furnish air handling and heat removal data for lighting fixtures specified with these requirements.

1.5 REQUIREMENTS OF REGULATORY AGENCIES

A. WORK IN ACCORDANCE WITH:

1. National Electrical Code.
2. Local, municipal, or state codes that have jurisdiction.
3. UL fire resistance directory.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General:

Provide the size, type and rating of each lighting fixture shown and scheduled. All lighting fixtures shall complete with reflectors, lens, trim rings, flanges, lamps, lamp holders, ballast, starters, fuses, wiring, earthquake clips, etc. to provide a complete functioning lighting fixture.

B. Lighting Fixture Types:

1. LED Fixtures
   a. Fixtures shall be pre-wired with frame-in kit and integral thermal protection required by UL for recessed fixtures. Driver shall be encased in metal-can construction for optimal thermal performance.
   b. Total fixture lumen output is dependent on the chip, thermal management, driver current and optical system. LED fixtures shall be tested as a complete unit or system. Only DOE recognized CALiPER testing laboratory results shall be utilized.
   c. LED fixtures shall have integral common mode and differential mode surge protection of 3kV (1.2/50µs, 2 ohm combination wave).
2. Exit signs
   a. Exit signs shall meet all federal, state and local codes.
   b. Provide fire alarm interface relay when required to flash exit signs.
   c. Provide battery packs for emergency operation when not connected to emergency generator power.

2.2 BALLASTS AND DRIVERS - COORDINATE WITH LIGHT FIXTURE SCHEDULE

A. LED

1. Driver manufacturer shall have a 10-year history producing electronic drivers for the North American market.
2. Driver shall carry a five year limited warranty from date of manufacture against defects in material or workmanship (including replacement) for operation at a maximum case temperature of 80 degrees Celsius.
3. Drivers shall not contain any Polychlorinated Biphenyl (PCB).
4. Provide driver with integral color-coded leads.
5. Driver shall operate from 50/60 Hz input source of 120 Volt through 277 Volt or 347 Volt through 480 Volt with sustained variations of +/- 10% (voltage) with no damage to the driver.
6. Driver output shall be regulated to +/- 5% across published load range. And shall have a power factor greater than .90 for primary application to 50% of full load rating with an input current Total Harmonic Distortion (THD) of less than 20% to 50% of full load rating.
7. Provide drivers with a Class A sound rating.
8. Provide LED drivers for outdoor fixtures with a minimum operating temperature of -40 degrees Celsius (-40 F). Provide LED drivers for indoor fixtures with a minimum operating temperature of -20 degrees Celsius (-2F).
9. Drivers shall tolerate sustained open circuit and short circuit output conditions without fail and auto-resetting without need for external fuses or trip devices.
10. Driver output ripple current shall be less than 15% measured peak-to-average, with ripple frequency being greater than 100Hz.
11. Driver performance requirements shall be met when operated to 50% of full load rating.
12. Driver shall have integral thermal foldback to reduce driver power above rated case temperature to protect the driver if temperatures reach unacceptable levels.
13. Drivers shall comply with NEMA 410 for in-rush current limits.
14. Dimmable drivers shall be controlled by a Class 2 low voltage 0-10VDC controller with dimming range controlled between 1 and 8VDC with source current 150µA.

2.3 LAMPS – COORDINATE WITH LIGHT FIXTURE SCHEDULE

A. LED Lamps shall be appropriately matched to the driver with junction-down design for improved thermal management. Maximum DC Forward Current.

2.4 EMERGENCY BATTERY BALLAST

A. Provide Bodine #BSL310LPST emergency battery ballast with self-test diagnostic circuitry for emergency lighting fixtures using LED lamps.

B. Provide unswitched hot leg. Hot leg shall originate from the same branch circuit as required in NEC article 700.12 (F).

C. Provide battery packs with minimum 1000 lumen output for linear fluorescent, compact fluorescent, or LED lamps. Provide with remote test switch where integral test switch is not available.

2.5 POLES

A. Provide poles for area lighting fixtures as specified. Steel poles shall be one piece**,** anchor base direct buried**,** with 2-piece steel bolt cover and vibration dampers. Poles shall be round straight steel aluminum**,** as specified on the Lighting Fixture Schedule. Poles shall be designed for 115 MPH wind load with 1.3 gust factor.

B. Provide all poles with appropriate mounting accessories including arms, tenons, or bullhorns as required. Anchor bolts shall hot dipped galvanized, sized as required by the manufacturer of the pole.

C. All poles shall have a nominal 3” x 5” hand hole at 18” above the base flange and grounding provision.

D. Poles shall be prime painted interior and exterior. The exterior shall be finished with polyester powder coating and architectural finish as specified by the Architect. The interior with 3 mil thermoplastic hydrocarbon resin, or equivalent to meet 1000 hour salt spray exposure (ASTM B-117).

PART 3 - EXECUTION

3.1 INSTALLATIONS

A. General

1. Install the type of lighting fixture where shown and indicated in accordance with manufacturer's written instructions.
2. Adjust all adjustable lighting fixtures, as directed by the Architect.
3. Provide safety chains and wire guards for lighting fixtures located in gymnasium, multi-purpose rooms, play areas, etc.

B. Coordination

1. The contractor shall verify the type of fixtures with the ceiling types as indicated on the drawings. Any discrepancies shall immediately be brought to the architect's attention before the contractor places his order and accepts delivery. Fixtures shall fit exact in the type of ceiling scheduled. Provide plaster frames, trim rings and other accessories required for a correct fit.

2. Provide supports attached to structural member to support fixtures when the ceiling system cannot maintain support. Provide separate supports for all recessed ceiling mounted HID fixtures.
3. Refer to architectural reflected ceiling plan for the exact location of all lighting fixtures. Notify the architect for any discrepancies or conflicts with structural, architectural, mechanical piping or ductwork before installation.

C. Mounting

1. Provide support channels to support outlet boxes used support surface mounted lighting fixtures such as exit signs or downlights.
2. Pendant or surface mounted fixture shall be provided with required mounting devices and accessories, including hickeys and stud-extensions, ball-aligners, canopies and stems. Locations of fixtures in mechanical areas shall be coordinated with mechanical contractor. Mounting stems of pendant fixtures shall be of the correct length to uniformly maintain the fixture heights shown on the drawings or established in the field. The allowable variation tolerance in mounting individual fixtures shall not exceed 1/4 inch and shall not vary more than 1/2 inch from the floor mounting height shown on the Drawings. Fixtures hung in continuous runs shall be installed absolutely level and in line with each other. Hanging devices shall comply with Code requirements. Fixtures shall employ single - not twin - stem hangers unless otherwise noted.
3. All structure mounted fixtures (i.e. bracket mounted, pipe mounted and surface mounted) shall be provided with cables of suitable size and weight to support the weight of the fixture. Cables shall be fastened around or fastened to the housing of the fixture. On pendant fixtures, one safety cable of suitable size and weight to support the weight of the fixture assembly shall connect the top of the pendant to the supporting structure by means of welding or bolting, and one safety cable shall connect the housing of the fixture to the bottom of the pendant. Where more than one pendant per fixture occurs, only one pendant must be cabled. Track fixtures for pendant mounted track shall also be supplied with clip-on safety cables of suitable size and weight to support the weight of the fixture.
4. Provide secondary support wires from all four (4) corners of the lay-in fixtures to the structure above. Do not support fixtures from ceiling grid wire supports, piping, conduit, side walls, or mechanical equipment. Ceiling specifications do not supersede this requirement.
5. Where pole mounted luminaires are provided, provide appropriate anchor base pole as specified with manufacturer’s recommended anchor bolts. Verify exact location on site for poles with Architect, Civil and Landscape documents. Poles shall be installed on proper footing. Refer to details on the drawings. Provide grounding connection to a separately driven ground rod, outside of the footing. Where indicated, provide pole with Identification plate indicating pole number.

D. Electrical Connection

1. All lighting fixtures shall be connected from a branch circuit junction box using 1/2" flexible metal conduit not exceeding 8'-0” or MC cable fixture pigtails not exceeding 6'-0”, where allowed. All fixtures must be grounded by using a grounding conductor. Fixture to fixture wiring of fixtures installed in an accessible ceiling is not permitted. Fixture whips shall not lay-on ceiling tile or grid. Provide caddy clips to provide additional support.

E. Fire Rated Ceiling

1. Provide fire rated canopy or enclosure for all fixtures recessed in a fire rated ceiling. The fire rated canopy or enclosure shall be as required by the UL design

number listed in the UL fire resistance directory. Refer to architectural drawing for the UL design number. Coordinate with ceiling installer and manufacturer. Provide proper rated ballast/drivers for lighting fixtures installed within these rated enclosures.

3.2 FINAL INSPECTION

A. Remove all plastic and protective coating from all fixtures. Fixtures shall be thoroughly cleaned. Replace any damaged fixture or fixture parts including reflectors, louvers, lens and metal parts that show signs of corrosion.

B. All final incandescent lamps used during construction shall be replaced with new lamps. Replace all other defective ballast, lamps or discolored lamps, showing signs of excessive usage.

C. Demonstrate proper operation of all fixtures and controls. Refer to other Sections and Details on the Drawings for Lighting Controls.

END OF SECTION

SECTION 321313 - CONCRETE PAVING

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 Concrete Paving. Including the Following:

1. Cast in Place Concrete.
2. Sandblast Finish Concrete.
3. Integral Colored Concrete with Acid Wash Finish.
4. Concrete Stepping Pads.
5. Planter Curb.
6. Curbing at Rubberized Fall Surface.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for foundations and footings, steps, walls, and general building applications of concrete.
2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

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

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and concrete paving construction practices.
c. Mockups.

2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

    a. Contractor's superintendent.
    b. Concrete paving Subcontractor.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
    1. Color additives.
    2. Surface retarders.

B. Sustainable Design Submittals:

    1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
    2. Product Certificates: For materials manufactured within 50 miles of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.
    3. Laboratory Test Reports: For concrete paving mixtures, documentation indicating that cured concrete complies with Solar Reflectance Index requirements.

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

D. Shop Drawings: Indicate extent of each concrete mixture.

E. Samples for Verification: Submit sample chip of specified concrete colors indicating Davis Color and name.

1.6 INFORMATIONAL SUBMITTALS

A. Material Certificates: For the following, from manufacturer:

    1. Cementitious materials.
    2. Steel reinforcement and reinforcement accessories.
    3. Fiber reinforcement.
    4. Admixtures.
    5. Curing compounds.
    6. Applied finish materials.
    7. Bonding agent or epoxy adhesive.
    8. Joint fillers.

B. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Ready-Mix-Concrete 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" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

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

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.

2. Build mockups of concrete paving in location where directed by Owner and of size indicated. Mockups to be removed and disposed of when no longer required for comparison with finished work.

a. Cast in Place Concrete: Not less than 96 inches by 96 inches.
1) Include samples of broom finish – light, medium-light, and medium for review and selection by Landscape Architect.

b. Sandblast Finish Concrete: Not less than 96 inches by 96 inches.
1) Include sample levels of sandblast finish – medium, medium-heavy, and heavy – for review and selection by Landscape Architect.

c. Integral Colored Concrete with Acid Wash Finish: Not less than 96 inches by 96 inches.
1) Include sample levels of acid wash finish with – Dayton Top-Cast® Yellow 15, Top-Cast® Beige 25, Top-Cast® Blue 75, on top of Davis Integral Colored Concrete

d. Concrete Stepping Pads: Three Stepping Pads. Full Width and Length as outlined on Plans

e. Planter curb: Full width and height by 96-inch length.

f. Curb at Rubberized fall surface: Full width and height by 96-inch length.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Landscape 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.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.9 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

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.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 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 in 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.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

C. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.

D. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

E. Tie Bars: ASTM A 615/A 615M, Grade 60; deformed.

F. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

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

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.4 CONCRETE MATERIALS

A. Regional Materials: Concrete shall be manufactured within 500 miles of Project site from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site.

B. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C 150/C 150M, gray Portland cement Type I.
2. Fly Ash: ASTM C 618, Class C or Class F.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 1N, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years'

satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain no more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

F. Water: Potable and complying with ASTM C 94/C 94M.

2.5 COLOR ADDITIVES

A. Manufacturer: Davis Colors
1. Contact Information:
   a. Phone: 800-356-4848 or 323-269-7311.
   b. E-mail: info@daviscolors.com.
   c. Web Site: www.daviscolors.com.
2. Substitutions: Comply with Division 01 Section "Substitution Procedures"

B. Type:
1. Concentrated pigments specially processed for mixing into concrete and complying with ASTM C979.
2. Color additives containing carbon black are acceptable.

C. Color Additive Delivery:
1. Automated Dispensing: Meter and dispense colors using computer-controlled automated color weighing and dispensing system. Use Davis Colors Chameleon liquid metering system and Hydrotint liquid color additives.
2. Manual Dispensing: Use Davis Colors Mix-Ready powdered color additives in pre-measured disintegrating bags.

2.6 CONCRETE COLORS

A. Concrete colors:
1. Integral Colored Concrete with Acid Wash Finish
   a. Name: Graphite
   b. Number: 8084

2.7 SURFACE RETARDER

A. Manufacturer: Dayton Superior
1. Contact Information:
   a. Phone: 877-977-9600

b. Web Site: www.daytonsuperior.com
2. Substitutions: Comply with Division 01 Section "Substitution Procedures"

2.8 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.

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

C. Water: Potable.

D. Evaporation –er: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.9 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork in preformed strips.

2.10 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash or Pozzolan: Up to 25 percent.
2. Slag Cement: Up to 50 percent.
3. Combined Fly Ash or Pozzolan, and Slag Cement: Up to 50 percent, with fly ash or pozzolan not exceeding 25 percent.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 4-1/2 percent plus or minus 1-1/2 percent for 1-1/2-inch nominal maximum aggregate size.

D. Chloride-containing admixtures are not permitted.

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

1. Use water-reducing admixture in concrete as required for placement and workability.

F. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 3500 psi.
2. Maximum W/C Ratio at Point of Placement: 0.55.
3. Slump Limit: 4 inches, plus or minus 1 inch.

G. Color Additives: Mix in accordance with manufacturer's instructions. Mix until color additives are uniformly dispersed throughout mixture and disintegrating bags, if used, have disintegrated.

H. Do not retemper mix or add water in field.

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

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

3.2 INSTALLATION

A. Comply with color admixture manufacturer's recommendations unless otherwise specified in this Section.

3.3 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.4 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.5 STEEL REINFORCEMENT INSTALLATION

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

3.6 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation (Expansion) Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints as indicated.
2. Extend joint fillers full width and depth of joint.

3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface.
4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
5. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Doweled Isolation (Expansion) Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Contraction (Control) Joints: Form weakened-plane contraction (control) joints, sectioning concrete into areas as indicated. Construct contraction (control) joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.

F. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove ice or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.8 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.9 SPECIAL FINISHES

A. Sandblast Finish: Expose coarse aggregate in paving surface as follows:

1. Sandblasting shall occur in locations as indicated.
2. Sandblast surface to depth required to achieve a medium-heavy finish.
3. Conduct sandblasting operations not prior than 36 hours after concrete casting with equipment and air pressure required to achieve desired surface finish.

    a. Air Compressor: Minimum capacity of 300 cfm per nozzle.
    b. Nozzle: Venturi-type with minimum inside diameter of 3/8-inch. Air pressure to be a minimum of 100 psi.
    c. Hose: High abrasion- and weather-, ozone- and pressure-resistant rubber, with strength suitable for sandblasting. Inside diameter to be no less than 1-1/2-inch diameter.

4. When blasting surface, hold nozzle perpendicular to and at a distance from surface to produce desired surface finish. Blast only surfaces to receive sandblasted finish.
5. Protect adjacent surfaces from sandblasting operations.

B. Integral Colored Concrete with Acid Wash Finish: Expose coarse aggregate in paving surface as follows: Spray Applied, film forming top surface retarder, designed for specific sized aggregates and finish requirements. Color coded to allow for ease of application and verification of grade being used as well as even and complete coverage.

1. Soon after the final seal finish has been completed spray GCP Applied Technologies "Top Cast" surface retarder using a low pressure sprayer with a 0.5gpm tip at a rate of 200—350 sq./ft. per gallon in a full hiding coat. a.
    a. Once dry GCP Applied Technologies "Top Cast "will yield a coating that provides intermittent rain protection. Once completely dry it can be covered to protect the surface if heavy extended rains are predicted.
    b. Wash surface with water rinse using stiff brooms and water hose or by high pressure washing with power equipment as early as 4-16 depending on weather conditions. Retarder removal intervals are dependent upon strength of the concrete mix, aggregate size, and desired washing techniques. Earlier washing on the light etches may be necessary. Verify in accordance with the mock-up approval detailed herein. 3. Rinse water and cement matrix removal shall be in accordance with local codes and should not be allowed to be washed or flow down to arroyos, storm sewers, ponds, streams or sanitary sewers by precipitation or other surface flows. 4. Prior to completion of the project, remove wash water residue from the site to location approved by the local district.

3.10 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

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

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound or a combination of these as follows:

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 lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or 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.

a. Do not use for concrete sub slabs where unit pavers, stone pavers, tile, or other material will be set in mortar as final finish surface material.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch.
2. Thickness: Plus 3/8-inch, minus 1/4 inch.
3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch.
6. Vertical Alignment of Dowels: 1/4 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
8. Joint Spacing: 3 inches.
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231/C 231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.

a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equal or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results shall be reported in writing to Landscape Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

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

I. Prepare test and inspection reports.

3.13 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Landscape Architect.

B. Drill test cores, where directed by Landscape Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373 – CONCRETE PAVEMENT 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, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Joint sealants for expansion joints.
2. Joint-sealant backer materials.

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. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of joint sealant and accessory.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockup: Build mockup to verify selections made under sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

C. 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. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
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.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backing materials, 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.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Self-Leveling, Premium-Grade Polyurethane, Elastomeric Joint Sealant: ASTM C 920, Type S, Grade P, Class 25, for Use T.

1. Color to be selected by Landscape Architect from Manufacturer’s full range. Design intent is for color to match concrete.

2.3 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.4 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backings to support joint 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 joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backing installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact 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.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements 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 joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION 321373

SECTION 321400 - UNIT PAVING

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. Brick Pavers.
2. Lueders Limestone Pavers.
3. Concrete Pavers.
4. Porcelain Pavers.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for concrete base under unit pavers and for cast-in-place concrete curbs and gutters serving as edge restraints for unit pavers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Stie.

1.4 ACTION SUBMITTALS

A. Product Data:

1. For materials other than water and aggregates.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Cleaning methods.
5. For the following:
    a. Pavers.
    b. Mortar and grout materials.
    c. Edge restraints.

B. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C136.

C. Samples for Verification: For each product, finish and color specified, two full-size samples representing actual products, colors, and textures.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Adhesion and Compatibility Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.

C. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.

1. For solid interlocking paving units, include test data for freezing and thawing according to ASTM C67.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years of experience.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified. Installer's field supervisor shall have Concrete Paver Installer Certification from the Interlocking Concrete Pavement Institute (ICPI) with the following designations:

1. Commercial Paver Technician Designation.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution. Mockup to be no smaller than 60 inches by 60 inches and to include all details outlined on Drawings for Landscape Architect’s review.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Submit to latex-additive manufacturer, for testing as indicated below, Samples of flooring materials that will contact or affect mortar and grout that contain latex additives.

1. Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimal adhesion with, and will be nonstaining to, installed brick and other materials constituting brick flooring installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle materials and products in strict compliance with manufacturer's instructions and recommendations and industry standards.

B. Store materials in manufacturer's original sealed, labeled packaging until ready for installation and in accordance with manufacturer's instructions. Protect from damage.

C. Store pavers 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.

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

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

F. Store liquids in tightly closed containers protected from freezing.

G. Store asphalt cement and other bituminous materials in tightly closed containers.

1.9 FIELD CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
    a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations on items other than Brick Pavers: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

B. Source Limitations Brick Pavers:

Acceptable Manufacturer: Endicott Clay Products Co., which is located at: 57120 707th Rd.; Endicott, NE 68350; Tel: 402-729-3315; Fax: 402-729-5804; Email: request info (endicott@endicott.com); Web: http://www.endicott.com

1. Substitutions: Not permitted.
2. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

2.2 BRICK PAVERS

A. Brick Pavers, Light-Traffic Paving Brick: Nominal 4-inch x 8-inch brick pavers with wirecut surface texture as manufactured by Endicott Clay Products Co.

1. Thickness: 2-1/4 inches.
2. Face Size: 4 by 8 inches.
3. Colors: Medium Ironspot No. 77, Medium Ironspot No. 46, Dark Ironspot.

B. Handicap Detectable Warning Brick Pavers, Light-Traffic Paving Brick: Nominal 4-inch x 8-inch brick pavers with Handicap Detectable Warning Devices as manufactured by Endicott Clay Products Co.

1. Thickness: 2-1/4 inches.
2. Face Size: 4 by 8 inches.
3. Colors: Coppertone

2.3 CONCRETE PAVERS

A. Concrete Pavers, Solid Paving Units, Normal-Weight Concrete: Solid paving units made from normal-weight concrete with a compressive strength not less than 3000 psi water absorption not more than 5 percent according to ASTM C140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C67.

1. Thickness: 2 inches.
2. Face Size and Shape:
   a. As indicated on Drawings.
3. Color: As selected by Landscape Architect from manufacturer's full range.

2.4 LUEDERS LIMESTONE PAVERS

A. Lueders Limestone Pavers: Rectangular paving slabs made from limestone complying with ASTM C568/C568M.

1. Classification: III High-Density.
2. Stone Abrasion Resistance: Minimum value of 10, based on testing according to ASTM C241/C241M or ASTM C1353.
3. Finish: Smooth.
4. Color: As selected by Landscape Architect from manufacturer's full range.
5. Thickness: Not less than 1-1/2 inches unless otherwise indicated.
6. Face Size: As indicated on Drawings.

2.5 PORCELAIN PAVERS

A. Basis of Design Product: Diplomacy Color Body Porcelain Pavers, as manufactured by Daltile, Dallas TX, 1-800-933-8453 or approved equal.

1. Finish: Textured, Slip Resistance rating of 0.60 or greater based on testing according to ANSI A137.1-A326.3 for exterior floor applications including pool decking.
2. Color: Dark Grey DP03.
3. Thickness: 13/16” (2cm).
4. Face Size: 20 x 40 (19-1/2” x 39-3/16”).

2.6 CURBS AND EDGE RESTRAINTS

A. Job-Built Concrete Edge Restraints: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi.

2.7 ACCESSORIES

A. Cork Joint Filler: Preformed strips complying with ASTM D1752, Type II.

B. Compressible Foam Filler: Preformed strips complying with ASTM D1056, Grade 2A1.

2.8 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D2940/D2940M, base material.

B. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C33/C33M for fine aggregate.

C. Stone Screenings for Leveling Course: Sound stone screenings complying with ASTM D448 for Size No. 10.

D. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.

1. Provide sand of color needed to produce required joint color.

E. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2, AASHTO M 288.
2. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751.
3. Permittivity: 0.02 per second, minimum; ASTM D4491.
4. UV Stability: 50 percent after 500 hours' exposure, ASTM D4355.

F. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2, AASHTO M 288.
2. Apparent Opening Size: No. 40 sieve, maximum; ASTM D4751.
3. Permittivity: 0.5 per second, minimum; ASTM D4491.
4. UV Stability: 50 percent after 500 hours' exposure, ASTM D4355.

2.9 MORTAR SETTING-BED MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II.

B. Hydrated Lime: ASTM C207, Type S.

C. Sand: ASTM C144.

D. Latex Additive: Manufacturer's standard emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.

E. Thin-Set Mortar for Bond Coat: Latex-portland cement mortar complying with ANSI A118.4.

1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
2. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
3. Provide product that is approved by manufacturer for application thickness of 1inch.

F. Water: Potable.

G. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches by 0.062 inch in diameter; comply with ASTM A185/A185M and ASTM A82/A82M except for minimum wire size.

2.10 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, made of white or gray cement and white or colored aggregate as required to produce color indicated.

1. Colored Mortar Pigments for Grout: Natural and synthetic iron and chromium oxides, compounded for use in mortar and grout mixes. Use only pigments that have proved, through testing and experience, to be satisfactory for use in portland cement grout.

B. Grout Colors: As selected by Landscape Architect from manufacturer's full range.

C. Water: Potable.

2.11 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimal performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

B. Mortar-Bed Bond Coat: Mix neat cement and water to a creamy consistency.

C. Portland Cement-Lime Setting-Bed Mortar: Type M complying with ASTM C270, Proportion Specification.

D. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.

E. Latex-Modified, Portland Cement Bond Coat: Proportion and mix portland cement, aggregate, and liquid latex for bond coat to comply with written instructions of liquid-latex manufacturer.

F. Thinset Mortar Bond Coat: Proportion and mix according to manufacturer's written instructions.

G. Job-Mixed Portland Cement Grout: Proportion and mix job-mixed portland cement and aggregate grout to match setting-bed mortar except omit hydrated lime and use enough water to produce a pourable mixture.

1. Pigmented Grout: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1 to 10, by weight.
2. Colored-Aggregate Grout: Produce color required by combining colored aggregates with portland cement of selected color.

H. Packaged Grout: Proportion and mix according to grout manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

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

3.2 PREPARATION

A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

C. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive subbase and base course for unit pavers.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

1. For concrete pavers, a block splitter may be used.

D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

E. Joint Pattern: As indicated on Drawings.

F. Tolerances:

1. Do not exceed 1/32-inch unit-to-unit offset from flush (lippage) or 1/8 inch in 10 feet from level, or indicated slope, for finished surface of paving.
2. Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

G. Expansion and Control Joints:

1. Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints unless otherwise indicated. Install joint filler before setting pavers. Sealant materials and installation are specified in Section 079200 "Joint Sealants."
2. Provide cork joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.

H. Provide edge restraints as indicated on Drawings. Install edge restraints before placing unit pavers.

1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
2. For metal edge restraints with top edge exposed, drive stakes at least 1 inch below top edge.
3. Install job-built concrete edge restraints to comply with requirements in Section 033000 "Cast-in-Place Concrete."
4. Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.
5. Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install pavers embedded in concrete and allow concrete to cure before placing aggregate setting bed and remainder of pavers. Hold top of concrete below aggregate setting bed.

I. Provide steps made of pavers as indicated on Drawings. Install paver steps before installing adjacent pavers.

1. Where pavers set in mortar bed are indicated for steps constructed adjacent to pavers set in aggregate setting bed, install steps, and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.

3.4 AGGREGATE SETTING-BED APPLICATIONS

A. Compact soil subgrade uniformly to at least 95 percent of ASTM D698 laboratory density.

B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Landscape Architect, and replace with compacted backfill or fill as directed.

C. Place separation geotextile over prepared subgrade, overlapping ends and edges at least 12 inches.

D. Place aggregate subbase and base, compact by tamping with plate vibrator, and screed to depth indicated.

E. Place aggregate subbase and base, compact to 100 percent of ASTM D1557 maximum laboratory density, and screed to depth indicated.

F. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches.

G. Place leveling course and screed to a thickness of 1 to 1-1/2 inches, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.

H. Treat leveling course with herbicide to inhibit growth of grass and weeds.

I. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers.

1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.

J. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.

1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches of uncompacted pavers adjacent to temporary edges.
2. Before ending each day's work, compact installed concrete pavers except for 36-inch width of uncompacted pavers adjacent to temporary edges (laying faces).
3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches of laying face.
4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.

K. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

L. Do not allow traffic on installed pavers until sand has been vibrated into joints.

M. Repeat joint-filling process 30 days later.

3.5 MORTAR SETTING-BED APPLICATIONS

A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Do not exceed 1/16-inch thickness for bond coat. Limit area of bond coat to avoid its drying out before placing setting bed.

C. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

D. Place reinforcing wire over concrete subbase, lapped at joints by at least one full mesh and supported so mesh becomes embedded in the middle of mortar bed. Hold edges back from vertical surfaces approximately 1/2 inch.

E. Place mortar bed with reinforcing wire fully embedded in middle of mortar bed. Spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

F. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.

G. Wet brick pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

H. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- thick bond coat to mortar bed or to back of each paver with a flat trowel.

I. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

J. Spaced Joint Widths: Provide 3/8-inch nominal joint width with variations not exceeding plus or minus 1/8 inch.

K. Grouted Joints: Grout paver joints complying with ANSI A108.10.

L. Grout joints as soon as possible after initial set of setting bed.

1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
2. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.

M. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

3.6 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.

END OF SECTION 321400

SECTION 321440 - STONE PAVING

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. Lueders limestone blocks.
2. Decomposed granite.
3. Pea gravel.
4. Cibolo gravel.
5. Landscape boulders.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for concrete base under stone paving and for cast-in-place concrete curbs serving as edge restraints for stone paving.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Mortar and grout materials.

B. Sustainable Design Submittals:

1. Product Certificates: For materials manufactured within 500 miles of Project, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.
2. Aggregate extraction, harvest or recovery, and manufacture must occur within 50 miles of Project site.

C. Samples: For the following:

1. Lueders limestone blocks
2. Decomposed granite.

3. Pea gravel.
4. 1 1/2” Cibolo gravel.
5. 2-3” Cibolo gravel.
6. Landscape boulders.
7. Jointing mortar.
    a. Color – Standard, to be selected by Landscape Architect from Manufacturer’s full range. Submit full range of Samples for review and selection.

1.5 QUALITY ASSURANCE

A. 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 the following in location where directed by Owner and of size indicated:

    a. Lueders limestone blocks: Not less than 96 inches by 96 inches.
    b. Decomposed granite: Not less than 96 inches by 96 inches, including geotextile.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store stone paving on elevated platforms in a dry location. If stone paving is not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

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

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

D. Store liquids in tightly closed containers protected from freezing.

1.7 FIELD CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 STONE PAVING, GENERAL

A. Regional Materials: Stone shall be fabricated within 500 miles of Project site from materials that have been extracted, harvested, or recovered within 500 miles of Project site.

1. Aggregate extraction, harvest or recovery, and manufacture must occur within 50 miles of Project site.

2.3 LUEDERS LIMESTONE BLOCKS

A. Solid, natural stone; rectangular cut paving slabs made from indigenous Lueders, Texas limestone complying with ASTM C 568/C 568M.

1. Basis of Design Product: Lueders limestone, color - buff with darker nicotine colors/accents, finish – to be selected by Landscape Architect from manufacturer's full range, as supplied by Champion Stone Company, Lueders, TX, 325-548-2568 or approved equal.
2. Face size: As indicated on Drawings.
3. Thickness: As indicated on Drawings.
4. Strength: Minimum of 9,000 psi.

2.4 DECOMPOSED GRANITE

A. Crushed Aggregate/Rock: Clean, washed, sound, regionally sourced natural crushed granite stone or gravel as follows:

1. Color: Red to dark pink, to be selected by Landscape Architect from Manufacturer's full range.
2. Aggregate shall be composed of a mixture of unwashed, durable particles or fragments of granite containing clay fines to meet the following gradations:

a. 5/8-inch Sieve – 0 percent.
b. 3/8-inch Sieve – 15 percent minimum, 25 percent maximum.
c. No. 4 Sieve – 40 percent minimum, 55 percent maximum.
d. No. 10 Sieve – 60 percent minimum, 85 percent maximum.

3. Sourcing Region: Marble Falls, TX.

2.5 PEA GRAVEL

A. Semi-round aggregate: Rounded, hard, durable, riverbed gravel or tumbled stone, free of sand, loam, clay, and other foreign substances with particle size less than 1/2 inch in diameter; complying with ASTM C 136 for the following sieve analysis test results:

1. Color: Light beige with variations from grey to pink, to be selected by Landscape Architect from Manufacturer's full range.
2. Aggregate shall be composed of a mixture of unwashed, durable particles or fragments of granite containing clay fines to meet the following gradations:

   a. 1/2-inch Sieve – 100 percent.
   b. 3/8-inch Sieve – 80 percent maximum.
   c. 5/16-inch Sieve – 20 percent maximum.
   d. No. 4 Sieve – 8 percent maximum.
   e. No. 16 Sieve – 3 percent maximum.

2.6 CIBILO GRAVEL

A. Semi-round aggregate: Rounded, hard, durable, riverbed gravel or tumbled stone, free of sand.

1. Color: Light beige with variations from grey to pink, to be selected by Landscape Architect from Manufacturer's full range.

2. Sizing:
   a. 1 1/2" Cibolo gravel.
   b. 2-3" Cibolo gravel.

2.7 LANDSCAPE BOULDERS

A. Solid, natural stone; landscape boulders shall be regionally sourced and irregular in shape with a "Weathered" surface.

B. Boulders shall be free from marks or scars caused by construction equipment. The Landscape Architect shall be notified two weeks prior to the delivery of the boulders to the construction site. The delivered boulders shall receive the approval of the Landscape Architect prior to installation. After the arrangement of boulders is approved by the Landscape Architect, the contractor shall set the boulders in place and backfill around the boulders with specified materials as shown on the drawings, to set the boulders in a stable position and prevent future removal or displacement of the boulders.

1. Size: Boulders to range from 12" in diameter to 36" in diameter.

2.8 CURBS AND EDGE RESTRAINTS

A. Job-Built Concrete Edge Restraints: Comply with requirements in Section 321313 “Concrete Paving" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3500 psi.

2.9 MORTAR SETTING-BED MATERIALS

A. Regional Materials: Aggregate for mortar shall be manufactured within 50 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 50 miles of Project site.

B. Portland Cement: ASTM C 150/C 150M, Type I or Type II.

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

D. Sand: ASTM C 144.

E. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.

F. Thin-Set Mortar for Bond Coat: Latex-Portland cement mortar complying with ANSI A118.4.

1. Provide product that is approved by manufacturer for application thickness of 5/8 inch.

G. Water: Potable.

2.10 GROUT MATERIALS

A. Regional Materials: Aggregate for grout shall be manufactured within 50 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 50 miles of Project site.

B. Sand-Portland Cement Grout: ANSI A108.10, made of white or gray cement and white or colored aggregate as required to produce color indicated.

C. High-Performance Cement Grout: ANSI A118.7, sanded.

1. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

D. Grout Colors: As selected by Landscape Architect from manufacturer's full range.

2.11 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other

procedures needed to produce setting-bed and joint materials of uniform quality and with optimal performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

B. Mortar-Bed Bond Coat: Mix neat cement and latex additive water to a creamy consistency.

C. Portland Cement-Lime Setting-Bed Mortar: Type M complying with ASTM C 270, Proportion Specification.

D. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.

E. Latex-Modified, Portland Cement Bond Coat: Proportion and mix portland cement, aggregate, and liquid latex for bond coat to comply with written instructions of liquid-latex manufacturer.

F. Job-Mixed Portland Cement Grout: Proportion and mix job-mixed portland cement and aggregate grout to match setting-bed mortar except omit hydrated lime and use enough water to produce a pourable mixture.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive stone paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.

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

3.2 PREPARATION

A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.

B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

C. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with stone paving installation only after deficient subgrades have been corrected and are ready to receive base course or concrete subslab for stone paving.

3.3 INSTALLATION, GENERAL (STONE PADS AND CURBS)

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix stone pads and curbs from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut stone pads and curbs with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

D. Joint Pattern: As indicated on Drawings.

E. Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with paving.

F. Tolerances: Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) or 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

G. Provide edge restraints as indicated. Install edge restraints before placing stone paving.

1. Install job-built concrete edge restraints to comply with requirements in Section 321313 "Concrete Paving."

3.4 MORTAR SETTING-BED APPLICATIONS (STONE PADS AND CURBS)

A. Saturate concrete subslab with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

B. Apply mortar-bed bond coat over surface of concrete subslab about 15 minutes before placing mortar bed. Do not exceed 1/16-inch thickness for bond coat. Limit area of bond coat to avoid its drying out before placing setting bed.

C. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.

D. Mix and place only that amount of mortar bed that can be covered with stone pads and curbs before initial set. Before placing stone pads and curbs, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.

E. Place stone pads and curbs before initial set of cement occurs. Immediately before placing stone pads and curbs on mortar bed, apply uniform 1/16-inch-thick bond coat to mortar bed or to back of each stone pad and curb with a flat trowel.

F. Tamp or beat stone pads and curbs with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each stone pad and curb in a single operation before initial set of mortar; do not return to areas already set or disturb stone pads and curbs for purposes of realigning finished surfaces or adjusting joints.

G. Spaced Joint Widths: Provide joint width as indicated on Drawings with variations not exceeding plus or minus 1/16 inch.

H. Grouted Joints: Grout paver joints complying with ANSI A108.10.

I. Grout joints as soon as possible after initial set of setting bed.

1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
2. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

J. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

3.5 REPAIRING, POINTING, AND CLEANING (STONE PADS AND CURBS)

A. Remove and replace stone pads and curbs that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.

C. Cleaning: Remove excess grout from exposed stone pad and curb surfaces; wash and scrub clean.

3.6 DECOMPOSED GRANITE TRAIL INSTALLATION

A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density.

B. Do not proceed if subgrade is deficient or not approved by Landscape Architect. Contractor is responsible for correcting deficiencies at no additional cost to the Owner.

C. Place drainage geotextile over prepared subgrade, overlapping ends and edges at least 12 inches.

D. Place aggregate base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.

E. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

F. Place decomposed granite trail material and screed to thickness as indicated on Drawings, taking care that moisture content remains constant and density is loose and constant until compacted.

1. Compact to a minimum density of 95 percent.

G. Lines and Levels: Install aggregate course true to grade, properly coinciding with adjacent work and elevations with a maximum 2% cross slope.

1. Do not create low points for water to pond.
2. All surfaces shall be flush and meet smoothly and evenly.

H. Provide a finished surface uniform in texture and appearance.

3.7 STONE AGGREGATE INSTALLATION

A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density.

B. Do not proceed if subgrade is deficient or not approved by Landscape Architect. Contractor is responsible for correcting deficiencies at no additional cost to the Owner.

C. Place drainage geotextile over prepared subgrade, overlapping ends and edges at least 12 inches.

D. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

E. Place stone aggregate and screed to thickness as indicated on Drawings, taking care that moisture content remains constant and density is loose and constant until compacted.

1. Compact to a minimum density of 95 percent.

F. Lines and Levels: Install aggregate course true to grade, properly coinciding with adjacent work and elevations with a maximum 2% cross slope.

1. Do not create low points for water to pond.
2. All surfaces shall be flush and meet smoothly and evenly.

H. Provide a finished surface uniform in texture and appearance.

3.8 FIELD QUALITY CONTROL

A. Remove work that does not meet requirements defined herein or as directed by Landscape Architect. Replace as required and at no additional cost to the Owner.

B. Protect partially- and fully completed installation against damage by construction traffic.

END OF SECTION 321440

SECTION 321816.13 – PLAYGROUND PROTECTIVE SURFACING

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. Wood mulch play surfacing.
2. Sand surfacing.
3. Rubber Mound.
4. Rubber play surfacing.

1.3 DEFINITIONS

A. Definitions in ASTM F 2223 apply to Work of this Section.

B. Critical Height: Standard measure of shock attenuation according to ASTM F 2223; same as "critical fall height" in ASTM F 1292. According to ASTM F 1292, this approximates "the maximum fall height from which a life-threatening head injury would not be expected to occur."

C. SBR: Styrene-butadiene rubber.

D. Unitary Surfacing: A protective surfacing of one or more material components bound together to form a continuous surface; same as "unitary system" in ASTM F 2223.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For rubber play surfacing and rubber mound.

1. Include plans, sections, placement and penetration details, and attachment to substrates.
2. Include accessories and edge terminations.
3. Include patterns made by varying colors of surfacing.
4. Include fall heights and use zones for equipment and structures specified in Section 116800 "Play Field Equipment and Structures," coordinated with the critical heights for protective surfacing.

C. Samples for Initial Selection: For each type of exposed product and for each color and texture specified.

1. Wood mulch play surfacing: 1 quart sealed container.
2. Sand surfacing: 1 quart sealed container.
3. Rubber mound: 12 inch by 12 inch minimum sample depicting wearing course and cushion layer for each color specified on the Plans.
4. Rubber play surfacing: 12 inch by 12 inch minimum sample depicting wearing course and cushion layer for each color specified on the Plans.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of unitary surfacing product.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For playground protective surfacing 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 set quality standards for materials and execution.

1. Build mockups for protective surfacing including accessories.
   a. Size: 48 inches by 48 inches
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.

1.8 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of protective surfacing that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Reduction in impact attenuation as measured by reduction of critical fall height.
   b. Deterioration of protective surfacing and other materials beyond normal weathering.
2. Warranty Period: Five years from date of Substantial Completion for rubber play surfacing and rubber mound.

3. Warranty Period: Fifteen years from date of Substantial Completion for engineered wood fiber.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain protective surfacing materials from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Impact Attenuation: Critical fall height tested according to ASTM F 1292.

B. Accessibility Standard: Minimum surfacing performance according to ASTM F 1951.

2.3 RUBBER PLAY SURFACING

A. Description: Manufacturer's standard, site-mixed and applied, two-layer material with wearing layer over cushioning layer, with combined, overall thickness as required, tested for impact attenuation according to ASTM F 1292 and for accessibility according to ASTM F 1951.

1. Basis of Design Product: Dura Play EPDM poured in place rubber playground surfacing as manufactured by DuraPlay, Inc. 150 Brownson Lane, Driftwood Texas, (512) 847-2473, or approved equal.
2. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 20 percent of total materials cost.
3. Overall Thickness: Not less than as required for critical height indicated on Drawings.
4. Primer/Adhesive: Manufacturer's standard primer and weather-resistant, moisture-cured polyurethane adhesive suitable for unit, substrate, and location.
5. Wearing Layer Color(s): Manufacturer’s standard to match color and pattern as indicated on Drawings.
6. Leveling and Patching Material: Portland cement-based grout or epoxy- or polyurethane-based formulation suitable for exterior use and approved by protective surfacing manufacturer.

2.4 ORGANIC LOOSE-FILL SURFACING

A. Engineered Wood Fiber: ASTM F 2075; shredded virgin wood fiber consisting of randomly sized pieces containing no bark, leaves, twigs, or foreign or toxic materials tested for accessibility according to ASTM F 1951.

1. Critical Height: As indicated on Drawings.
2. Uncompressed Material Depth: Not less than as indicated on Drawings.

2.5 INORGANIC LOOSE-FILL SURFACING

A. Inorganic Aggregate Materials: Clean, washed, and free of loam, clay, organic matter, debris, and other foreign substances.

1. Fine Sand: Complying with ASTM C 136 for the following sieve analysis test results:
   a. Sieve Sizes and Percent Passing through Screen: No. 16 passing 100 percent, No. 30 passing 98 percent, No. 50 passing 62 percent, No. 100 passing 17 percent, and No. 200 passing zero to 1 percent.
2. Critical Height: As indicated on Drawings.
3. Uncompressed Material Depth: Not less than as required for critical height indicated.

2.6 LOOSE-FILL ACCESSORIES

A. A. Stabilizing Mats: Water-permeable PVC or rubber mats tested for impact attenuation according to ASTM F 1292, with anchoring system designed to anchor mat securely to subgrade through loose fill, and rated for use in the following locations:

1. At high-traffic areas and playground equipment where indicated on Drawings.

2.7 GEOSYNTHETIC ACCESSORIES

A. Drainage/Separation Geotextile: Nonwoven, needle-punched geotextile, manufactured for drainage applications and made from polyolefins or polyesters; with the following minimum properties:

1. Weight: 4 oz./sq. yd.; ASTM D 5261.
2. Water Flow Rate: 100 gpm/sq. ft. according to ASTM D 4491.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for subgrade elevations, slope, and drainage and for other conditions affecting performance of the Work.

1. Verify that substrates are sound and without high spots, ridges, holes, and depressions.

B. Hard-Surface Substrates: Verify that substrates are satisfactory for unitary, protective surfacing installation and that substrate surfaces are dry, cured, and uniformly sloped to drain within recommended tolerances according to protective surfacing manufacturer's written requirements for cross-section profile.

1. Concrete Substrates: Verify that substrates are dry and free from surface defects, laitance, glaze, efflorescence, curing compounds, form-release agents, hardeners, dust, dirt, loose particles, grease, oil, and other contaminants incompatible with protective surfacing or that may interfere with adhesive bond. Determine adhesion, dryness, and acidity characteristics by performing procedures recommended in writing by protective surfacing manufacturer.

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

3.2 PREPARATION

A. Prepare substrates to receive surfacing products according to protective surfacing manufacturer's written instructions.

3.3 INSTALLATION OF GEOSYNTHETIC ACCESSORIES

A. Install geosynthetic accessories before edging and according to playground surface system manufacturer's and geosynthetic manufacturer's written instructions and in a manner that cannot become a tripping hazard.

1. Drainage/Separation Geotextile: Completely cover area beneath protective surfacing, overlapping geotextile sides and edges a minimum of 6 inches with manufacturer's standard treatment for seams.

B. Hard-Surface Substrates: Clean surface free of laitance, efflorescence, curing compounds, and other contaminants incompatible with protective surfacing.

1. Repair: Fill holes and depressions in unsatisfactory surfaces with leveling and patching material.
2. Treatment: Mechanically abrade or otherwise prepare concrete substrates according to protective surfacing manufacturer's written instructions to achieve adequate roughness.
3. Terminal Edges: Saw cut concrete for terminal edges of protective surfacing.
4. Treat control joints and other nonmoving substrate cracks to prevent telegraphing through protective surfacing.

3.4 INSTALLATION OF SEAMLESS SURFACING

A. Mix and apply components of seamless surfacing according to manufacturer's written instructions to produce uniform, monolithic, and impact-attenuating protective surfacing of required overall thickness.

1. Substrate Primer: Apply over prepared substrate at manufacturer's standard spreading rate for type of substrate.
2. Poured Cushioning Layer: Spread evenly over primed substrate to form a uniform layer applied at manufacturer's standard spreading rate in one continuous operation, with a minimum of cold joints.
3. Intercoat Primer: Over cured cushioning layer, apply primer at manufacturer's standard spreading rate.
4. Wearing Layer: Spread over primed base course to form a uniform layer applied at manufacturer's standard spreading rate in one continuous operation and, except where color changes, with no cold joints. Finish surface to produce manufacturer's standard wearing-surface texture.
    a. Design: Where colored pattern is required, place colored, design material as soon as previously placed material is sufficiently cured, using primer or adhesive if required by manufacturer's written instructions.
5. Edge Treatment: As indicated on Drawings.

3.5 INSTALLATION OF LOOSE-FILL SURFACING

A. Apply components of loose-fill surfacing according to manufacturer's written instructions to produce a uniform surface.

B. Edging: Place and permanently secure edging in place, and attach units to each other.

C. Loose Fill: Place loose-fill materials to required depth after installation of playground equipment support posts and foundations. Include manufacturer's recommended amount of additional material to offset natural compaction over time.

D. Stabilizing Mats: Coordinate installation of mats and mat anchoring system with placing loose fill.

E. Finish Grading: Hand rake to a uniformly smooth finished surface and to required elevations.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests.

B. Perform the following tests with the assistance of a factory-authorized representative:

1. Perform "Installed Surface Performance Test" according to ASTM F 1292 for each protective surfacing type and thickness in each playground area.

C. Playground protective surfacing will be considered defective if it does not pass tests.

D. Prepare test reports.

3.7 PROTECTION

Retain this article if applicable.

A. Prevent traffic over seamless surfacing for not less than 48 hours after installation.

END OF SECTION 321816.13

SECTION 323119 - DECORATIVE METAL FENCES AND GATES

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. Dog Park Fence.
2. Dog Park Gate.
3. Volleyball Fence.
4. Playground Fence.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

Shop Drawings: For fencing and gates. Include plans, elevations, sections, gate locations, post spacing, mounting, grounding details and attachment details to other work.

B. Samples: For each fence material and for each color specified.

1. Provide 12” section of each type of fence or gate pipe required.
2. Provide 12” x 12” sample of fence fabric.
3. Provide 6” sample of fabric tie material.
4. Provide sample of posts and post caps.
5. Provide sample of turnbuckles.
6. Provide sample of galvanized steel braided cable.

PART 2 - PRODUCTS

A. The types of fencing required for the project are as indicated below, subject to detailed material requirements which follow.

B. All fencing materials and components shall be black.

C. All material shall be new and products of recognized reputable manufacturers. Used, re-rolled or re-galvanized materials are not acceptable.

D. Like items of materials provided hereinafter shall be the end products of one manufacturer in order to achieve standardization for appearance, maintenance and replacement.

E. Fencing Fabric Wire shall conform to the following:

1. Fabric shall be premium grade helically wound and woven steel core wire in accordance with ASTM F668 for Class 2B vinyl fabric. Color to be black.

2. Material specifics shall be as follows:

	a. Core b. (inches)	Wire (gauge)	Zinc (oz/S.F.)	Mesh Size
Chain Link Fencing	0.148	9	.30	1.25”

3. Selvages: Fence fabric shall be knuckled selvage at top and bottom.

F. Powdercoated framework shall be steel pipe - Type II: Cold formed and welded steel pipe complying with ASTM F 1043, Group IC, with minimum yield strength of 50,000 psi (344 MPa), sizes as indicated. Protective coating per ASTM F 1043, external coating Type B, zinc with organic overcoat, 0.9 oz/ft² (275 g/m²) minimum zinc coating with chromate conversion coating and verifiable polymer film. Internal coating Type B, minimum 0.9 oz/ft² (275 g/m²) zinc or Type D, zinc pigmented, 81% nominal coating, minimum 3 mils (0.08 mm) thick. Color to be black.

1. Schedule of pipe sizes shall be as follows:

Application	Height (Feet)	Out Dim. (Inches)	Weight (lbs/foot)
Terminal/ Corner Posts	6’-0” & less	2.375	3.117
	over 6’-0”	4.00	6.56
Line Post	6’-0” & less	1.90	2.281
	Over 6’-0”	2.875	4.64
Rails and Braces	(all heights)	1.660	1.83

Gate Posts Refer to Chain Link Gate Section

G. Posts shall be of sufficient length to allow for installation into concrete footings or of sufficient length to allow for installation in the concrete curb as shown in the Project Plans and Details.

H. Post tops shall be provided with post caps which fit securely and exclude moisture.

I. Permanent Chain Link Fence Rails:

1. Top Rails shall have lengths not less than eighteen feet and shall be fitted with min. 6 inch long outside sleeved or internally swaged couplings for connecting the lengths into a continuous run. Provide top rail with pass-through fittings at line posts and rail end cups and brace bands at terminal or gate posts.

2. Middle and Bottom Rails shall be properly secured to line posts with steel boulevard

clamps, and to terminal, corner, gate or pull posts with rail end cups and brace bands.

3. Brace Rails shall be provided for each terminal post with fabric height of six feet or more. Extend brace to each adjacent post at approximate mid-height of fabric and secure with rail end cups and brace bands. Provide diagonal truss bracing with 3/8 inch steel rod and turnbuckle.

J. Fence Fittings and Accessories shall be fabricated of steel or cast iron and shall conform to minimum requirements of ASTM F-626, and as below. Following fabrication and galvanizing, all fence fittings shall receive a 10 to 14 mil thick fusion bonded vinyl coating to match fabric color. With the exception of field painting for nuts and bolts, no painted fittings will be accepted.

1. Stretcher Bars shall not be less than 3/16 by 3/4 inch and not less than 2 inches shorter than the nominal height of the fabric with which they are to be used. One stretcher bar shall be provided for each end and gate post, and two for each corner and pull post.

2. Fabric connectors shall be provided in sufficient number for attaching the fabric to all line posts at intervals not exceeding twelve inches (12"); and not exceeding twelve inches (12") when attaching fabric to top or bottom rail. Connectors shall be galvanized with a min. 0.8 oz s.f. coating of zinc.

3. Unless designated otherwise on the details, tie wires shall be fabricated from rolled 9-gauge wire stock which has been cut to required lengths for hand-twisted connections at the site. Color to be black.

4. Tension Bands shall be provided in sufficient number for attaching the fabric and stretcher bars to all terminal posts at intervals not exceeding twelve inches (12"). Tension bands shall be formed from flat or beveled steel and shall have a minimum thickness after galvanizing of 0.078 inch; and minimum width of 3/4 inch for posts 4-inch O.D. or less; and 0.108-inch thickness by 7/8 inch for posts larger than 4 inch O.D.

5. Brace bands shall be formed from flat or beveled steel and shall have a minimum thickness of 0.108 inch after galvanizing; and a minimum width of 3/4 inch. Attachment bolts shall be 5/16 x 1-1/4-inch galvanized carriage bolts with nuts, ASTM A-307, Grade A.

6. Other hardware required shall be fabricated from steel and galvanized in accordance with ASTM A123 and/or ASTM A153.

K. Chain Link Gates:

1. Fabricate chain link gates in accordance with ASTM F 900 using galvanized 2” steel tubular members weighing 2.60 lb/ft with fusion or stainless-steel welded connections forming a rigid one-piece unit.

2. Frames shall be thermally fused after fabrication with minimum 10 mils per ASTM 1043. Coating before fabrication will not be allowed.

3. Chain link fabric for gates shall match fabric of fencing.

4. Gate Posts shall be steel pipe – type II finished to match fence posts:

	Post Size (inches)	Weight (lb/ft.)
Gate leaf 4’ ht.	2.875	5.79

5. Gate hinges shall be heavy-duty offset type. Install gate for 180-degree outward operation. Hinges shall have large bearing surfaces for clamping in position. The hinges shall not twist or turn under the action of the gate. The gates shall be capable of being opened and closed easily by one person.
6. All gates shall be equipped with a positive closure latch and padlock fitting. All components to be ADA compliant.

PART 3 - EXECUTION

3.1 EXAMINATION

Verify that survey is specified in Section 017300 "Execution" or is otherwise available. Consider using sleeves to leave voids in new concrete substrates.

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

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

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

1. Construction layout and field engineering are specified in Section 017300 "Execution."

3.3 DECORATIVE FENCE INSTALLATION

A. General: Unless modified herein, installation of fencing shall meet the requirements of ASTM F567. Erect fencing in straight lines between angle points by skilled mechanics experienced in this type of construction.

B. Where chain link fence is not in a cast-in-place concrete curb: Set posts in concrete at indicated spacing into firm, undisturbed soil.

1. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than 48 inches.

For fences six feet and taller post holes shall be 4 times the post size and a depth of not less than 48 inches. Post holes for terminal or gate posts shall have a minimum diameter of 18 inches, by respective depths as specified.

2. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
3. Concrete Fill: Place concrete around posts and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    a. Exposed Concrete: Extend 2 inches above grade. Finish and slope top surface to drain water away from post.
4. Posts Set in Concrete: Extend post to within 6 inches of specified excavation depth, but not closer than 3 inches to bottom of concrete.
5. Space posts uniformly in fence line with the maximum spacing as indicated on Drawings.

C. Where chain link fence shall be cored into cast-in-place concrete curb: Prior to coring the post holes in the concrete curb, Contractor shall layout the fencing in the field to ensure proper spacing of the post holes.

    a. Post coring depth shall be as shown on the Project Details.
    b. Set posts with plumb vertical alignment and grout in place.
    c. All permanent posts shall be grouted into pvc sleeves casted into concrete curb.

3.4 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 GROUNDING AND BONDING

A. Fence Grounding: Install at maximum intervals of 1500 feet except as follows:

1. Fences within 100 Feet of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of 750 feet.

    a. Gates and Other Fence Openings: Ground fence on each side of opening.
        1) Bond metal gates to gate posts.

B. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.

C. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.

D. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.

END OF SECTION 323119

SECTION 329113 – SOIL PREPARATION

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 planting soils specified by composition of the mixes.

1. Solid Sod Soil.
2. Planting Soil.
3. Dry Soil.
4. Rain Garden Soil.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

B. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

C. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

D. Imported Soil: Soil that is transported to Project site for use.

E. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

F. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

G. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

H. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

I. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

J. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

K. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Sustainable Design Submittals:

1. Product Certificates: For materials manufactured within 50 miles of Project, indicating location of raw material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each raw material.

C. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1. Provide 1-quart volume of each Soil Type.

D. Soil Analysis Report: In accordance with requirements herein, conveying soil testing results and outlining recommendations for producing viable planting soil for each Soil Mix.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.8 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples of each soil type specified according to requirements of testing agency. Split each sample into two, equal parts. Send half to the testing agency and half to the Owner for their records.

1.9 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":
   a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
   b. Hydrometer Method: Report percentages of sand, silt, and clay.
2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.

4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT SERA-6 including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm and sodium absorption ratio.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.

Generally, adjust soil reaction (pH) only in soils where the pH is near the extreme ends of the acceptable range for the plants indicated.

2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.10 DELIVERY, STORAGE, AND HANDLING

Retain paragraphs in this article to suit Project. Limit inserts to only those unusual requirements not included in Section 016000 "Product Requirements."

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Regional Materials: Imported soil mixes, soil amendments and fertilizers shall be manufactured within 50 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 50 miles of Project site.

2.2 PLANTING SOILS SPECIFIED BY COMPOSITION

A. Solid Sod Soil: Manufactured soil consisting of manufacturer's basic sandy loam according to USDA textures, blended in a manufacturing facility with 40% sand, 40% silt, and 20% clay by volume and supplemented with compost, soil amendments and fertilizers in accordance with Soil Analysis Report to produce viable planting soil.

1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6.5 to 7.5 and minimum of 2 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
2. Unacceptable Properties: Manufactured soil shall not contain the following:

a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
b. Unsuitable Materials: Stones, roots, plants and sod that exceed a combined maximum of 2 percent by dry weight of the manufactured soil.
c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1-1/2 inches in any dimension.

B. Planting Soil: Manufactured soil consisting of manufacturer's basic sandy loam according to USDA textures, blended in a manufacturing facility with 70% sand, 20% silt, and 10% clay by volume and supplemented with compost, soil amendments and fertilizers in accordance with Soil Analysis Report to produce viable planting soil.

1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6.5 to 7.5 and minimum of 2 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
2. Unacceptable Properties: Manufactured soil shall not contain the following:

    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants and sod that exceed a combined maximum of 2 percent by dry weight of the manufactured soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1-1/2 inches in any dimension.

C. Dry Soil: Manufactured soil consisting of manufacturer's basic sandy loam according to USDA textures, blended in a manufacturing facility with 80% sand, 15% silt, and 5% clay by volume and supplemented with compost, soil amendments and fertilizers in accordance with Soil Analysis Report to produce viable planting soil.

1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6.5 to 7.5 and minimum of 2 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
2. Unacceptable Properties: Manufactured soil shall not contain the following:

    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants and sod that exceed a combined maximum of 2 percent by dry weight of the manufactured soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1-1/2 inches in any dimension.

D. Rain Garden Soil: Manufactured soil consisting of manufacturer's basic sandy loam according to USDA textures, blended in a manufacturing facility with 80% sand, 15% silt, and 5% clay by volume and supplemented with compost, soil amendments and fertilizers in accordance with Soil Analysis Report to produce viable planting soil.

1. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6.5 to 7.5 and minimum of 2 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
2. Unacceptable Properties: Manufactured soil shall not contain the following:

    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants and sod that exceed a combined maximum of 2 percent by dry weight of the manufactured soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1-1/2 inches in any dimension.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Class: T, with a minimum of 99 percent passing through a No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
2. Class: O, with a minimum of 95 percent passing through a No. 8 sieve and a minimum of 55 percent passing through a No. 60 sieve.
3. Form: Provide lime in form of ground limestone or mollusk shells.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.

F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M, with a Fines Modulus Index of 2.3 and 3.1.

1. Sands shall be clean, free of limestone, shale and slate particles. Sand pH shall be lower than 7.5.

2. Provide the following particle size distribution:

Sieve:	**Percent Passing:**
3/8” (9.5mm)	100
No. 4 (4.75mm)	95-100
No. 8 (2.36mm)	80-100
No. 16 (1.18mm)	50-85
No. 30 (.60mm)	25-60
No. 50 (.30mm)	5-30
No. 100 (.15mm)	0-10

2.4 ORGANIC SOIL AMENDMENTS

A. Compost shall be mature, stable, weed free, and produced by aerobic decomposition of organic matter. Compost shall be composed of but not limited to animal manures and bedding, hard and soft tree waste, coffee waste, and cotton waste. The product must not contain substances toxic to plants, or over 5% sand, silt, clay or rock material by dry weight. The product shall possess no objectionable odors. The product must meet all applicable USEPA CFR, Title 40, Part 503 Standards for Class A biosolids. The moisture level shall be such that no visible water or dust is produced when handling the material.

B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of maximum 5 dS/m.

C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a 1/2-inch sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of maximum 5 dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.5 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

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

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 4 inches Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Mixing: Spread unamended soil to total depth of 6 inches but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

1. Amendments: Apply soil amendments and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
    a. Mix lime with dry soil before mixing fertilizer.
    b. Mix fertilizer with planting soil no more than seven days before planting.
2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

D. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.

E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests:

1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 1000 sq. ft**.** in-place soil or part thereof.

C. Soil will be considered defective if it does not pass tests.

D. Prepare test reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.5 PROTECTION

A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Vehicle traffic.
4. Foot traffic.
5. Erection of sheds or structures.
6. Impoundment of water.
7. Excavation or other digging unless otherwise indicated.

B. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.6 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

END OF SECTION 329113

SECTION 329200 – TURF AND GRASSES

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. Section 329113 "Soil Preparation" and drawing designations for planting soils.
2. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants.

1.2 SUMMARY

A. Section Includes:

1. Sodding.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or AmericanHort.
2. Experience: Three years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD

A. Turfgrass Sod: Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects, complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.

B. Turfgrass Species: Sod of grass species as follows, with not less than 85 percent germination, not less than 95 percent pure see, and not more than 0.5 percent weed seed.

1. Provide Tifway 419 Bermuda Grass or approved equal.

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition:
   a. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition:
   a. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 PESTICIDES

A. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

B. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

1. Reduce elevation of planting soil to allow for soil thickness of sod.

B. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

C. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SODDING

A. Lay sod within 24 hours of harvesting unless a suitable preservation method is accepted by Architect prior to delivery time. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

1. Lay sod across slopes exceeding 1:3.
2. Anchor sod on slopes exceeding 1:6 with wood pegs or steel staples spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.

C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches below sod.

3.5 PLUGGING

Revise plug spacing in this article to suit Project. Zoysiagrass plugs may require spacing as close as 6 inches (150 mm) in northern areas to speed coverage.

A. Plant plugs in holes or furrows, spaced [**12 inches**] [**18 inches**] <**Insert dimension>** apart in [**both directions**] [**triangular pattern**]. On slopes, contour furrows to near level.

3.6 SPRIGGING

Sprigs may be row planted in furrows or broadcast and roller pressed into planting soil. Retain first paragraph below if planting sprigs in rows. Retain spacings to suit Project. Closer spacing results in more rapid establishment of slower-growing species.

A. Plant freshly shredded sod sprigs in furrows [**1 to 1-1/2 inches**] [**1-1/2 to 2 inches**] [**2-1/2 to 3 inches**] deep. Place individual sprigs with roots and portions of stem in moistened soil, [**6 inches**] [**12 inches**] <**Insert dimension>** apart in rows [**10 inches**] [**18 inches**] <**Insert dimension>** apart, and fill furrows without covering growing tips. Lightly roll and firm soil around sprigs after planting.

3.7 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow bermudagrass to a height of 1/2 to 1 inch.

D. Turf Postfertilization: Apply slow-release fertilizer after initial mowing and when grass is dry in accordance with requirements in Soil Analysis Report.

3.8 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.9 PESTICIDE APPLICATION

A. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.10 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.11 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Sodded Turf: 1 year from date of Substantial Completion.

END OF SECTION 329200

SECTION 329300 - PLANTS

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. Section 329113 "Soil Preparation" for planting soil requirements.
2. Section 329200 “Turf and Grasses” for turf (lawn) planting.

1.2 SUMMARY

A. Section Includes:

1. Plants.
2. Tree stabilization.
3. Landscape edgings.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

J. Planting Area: Areas to be planted.

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" for drawing designations for planting soils.

L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

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. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or

other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Samples for Verification: For each of the following:

1. Organic Mulch: 1 quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
2. Weed Control Barrier: 12 by 12 inches.
3. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
4. Root Barrier: Width of panel by 12 inches.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or AmericanHort.
2. Experience: Three years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:
   a. Landscape Industry Certified Technician - Exterior.
   b. Landscape Industry Certified Horticultural Technician.
5. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

Retain subparagraph below if allowances are required.

1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.

Revise "Measurements" Paragraph below to suit Project.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Architect of sources of planting materials at Preconstruction Meeting.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Bare-root stock plants are not permitted.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

Retain subparagraphs below to suit Project.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.11 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

1.12 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
   b. Structural failures including plantings falling or blowing over.
   c. Faulty performance of tree stabilization and edging.
   d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Periods: From date of Substantial Completion.
   a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
   b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
3. Include the following remedial actions as a minimum:
   a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.

b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
   a. Trees-Greater than 8-inch Caliper in Size: Shall be grown in boxes not less than 8 feet by 8 feet square. Basis of Design Supplier shall be Environmental Design Tomball, Texas, 281 376 4260 or approved equal.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

Retain first option in "Labeling" Paragraph below if many species of plants are required; retain second option if many plants of same species are required. Labeling is recommended unless an expert is available to identify plant material. Copy this paragraph and re-edit for labeling different types of plants if required.

D. Labeling: Label [**each**] [**at least one**] plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 FERTILIZERS

Revise descriptions in "Planting Tablets" Paragraph below and name proprietary products if required.

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 20 gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Shredded hardwood.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

2.4 WEED-CONTROL BARRIERS

A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd..

2.5 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.6 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes (For trees up to 8-inch caliper): Smooth, sound, new hardwood free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.
2. Wood Deadmen (For trees 8-inch caliper and greater):: Timbers measuring 8 inches in accordance with details on Drawings and smooth, sound new hardwood free of knots, holes, cross grain, and other defects of sizes indicated.

    a. Wood Screws: ASME B18.6.1
    b. Cable: Stainless-steel wire rope, Grade 304, 7x19 ¼-inch diameter.
    c. Cable Tensioner: Manufacturer's standard, stainless steel.

3. Guys and Tie Wires: ASTM A641/A641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch in diameter.
4. Tree Straps: 12 inch, woven polypropylene with brass grommets, minimum tear strength of 200 lbs. color beige.
5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
6. Flags: Standard surveyor's plastic flagging tape, white, 6 inches long.

2.7 LANDSCAPE EDGINGS

A. Steel Edging: Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.

1. Basis of Design Product: Steel landscape edging, as manufacturer by Pro-Steel, Fort Worth, TX, 1-800-542-4518
2. Edging Size: 3/16 inch thick by 4 inches deep, 14 Gauge.
3. Stakes: Tapered steel, a minimum of 12 inches long.
4. Accessories: Standard tapered ends, corners, and splicers.
5. Finish: Manufacturer's standard black powder coat finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

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

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

Retain one of first two paragraphs below if locations of trees and shrubs or other plantings are not indicated on Drawings or if final adjustment for delivered plant material is required. Retain layout requirements in first paragraph for large projects or if inspection and approval by Architect is required.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

B. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.

5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
8. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches (50 mm) maximum above adjacent finish grades.

1. Backfill: Planting soil per requirements in Section 329113 “Soil Preparation.”
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
    a. Quantity: one for every gallon, two for each caliper inch or one for every 12 inches of spread.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches (50 mm) maximum above adjacent finish grades.

1. Backfill: Planting soil per requirements in Section 329113 “Soil Preparation.”
2. Carefully remove root ball from container without damaging root ball or plant.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
    a. Quantity: one for every gallon, two for each caliper inch or one for every 12 inches of spread.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Fabric Bag-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 2 inches (50 mm) maximum above adjacent finish grades.

1. Backfill: Planting soil per requirements in Section 329113“Soil Preparation.”
2. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
    a. Quantity: one for every gallon, two for each caliper inch or one for every 12 inches of spread.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

F. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 MECHANIZED TREE-SPADE PLANTING

A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.

B. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.

C. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

D. Cut exposed roots cleanly during transplanting operations.

E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.

F. Where possible, orient the tree in the same direction as in its original location.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.8 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying:
    a. Stake trees of 2- through 5-inch caliper. Stake trees of less than 2-inch caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend to the dimension indicated on Drawings above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
    b. Stake trees with two stakes for trees up to 12 feet high and 2-1/2 inches or less in caliper; three stakes for trees less than 14 feet high and up to 4 inches in caliper. Space stakes equally around trees.
2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
3. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
    a. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to turnbuckle. Allow enough slack to avoid rigid restraint of tree.
    b. Attach flags to each guy wire, 30 inches above finish grade.
    c. Paint turnbuckles with luminescent white paint.
4. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions..

B. Root-Ball Stabilization(For trees 8 inches in caliper or greater in size): Install at- or below-grade stabilization system in accordance to details on Drawings to secure each new planting by the rootball unless otherwise indicated.

1. Ensure root ball stabilizers are installed in proper sequence and do not interfere with other planting or installation operations.

3.9 INSTALLATION OF ROOT BARRIER

A. Install root barrier as indicated on Drawings and in accordance with Manufacturer's written recommendations.

3.10 PLACING SOIL IN PLANTERS

A. Place a layer of drainage gravel at least 4 inches thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric 6 inches up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil-filling process.

B. Fill planter with planting soil type as indicated on Drawings. Place soil in lightly compacted layers to an elevation of 1-1/2 inches below top of planter, allowing natural settlement.

3.11 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil as indicated on Drawings for backfill.

C. Dig holes large enough to allow spreading of roots.

D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.12 PLANTING AREA MULCHING

A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches and secure seams with galvanized pins.

1. Install weed control barriers in planting areas as indicated on Drawings.

B. Mulch backfilled surfaces of planting areas and other areas indicated.

Retain required mulch applications in three subparagraphs below.

1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 24inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
2. Organic Mulch in Planting Areas: Apply organic mulch ring of 3-inch average thickness, with 24inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.

3.13 INSTALLATION OF EDGING

A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

3.14 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

D. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

F. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.15 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.16 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree.
2. Species of Replacement Trees: Same species being replaced or Species selected by Landscape Architect.

3.17 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.18 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 12 months from date of Substantial Completion.

B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 12 months from date of Substantial Completion.

END OF SECTION 329300