GLMV ARCHITECTURE, INC. 1525 E. Douglas Wichita, Kansas 67211

CITY OF LEE'S SUMMIT LEE'S SUMMIT - MARKET PLAZA LEE'S SUMMIT, MISSOURI

ARCHITECT'S PROJECT 18225R21006

ADDENDUM 1

Friday, December 22, 2023

The original Project Manual and Drawings for the Project noted above, dated November 1, 2023, are amended as indicated on this Addendum 1.

This Addendum consists of narrative, revised Specification Sections, and revised Drawings.

Manufacturers approved by this Addendum shall not be relieved of the responsibility to comply with the specifications stated or, if not stated, the standard specifications and accessories supplied with the item specified.

Note: Receipt of this Addendum shall be acknowledged on your Bid Form. Failure to do so may subject the Bidder to disqualification.

ITEM NO.

CHANGES TO PRIOR ADDENDA (Does Not Apply)

CHANGES TO BIDDING REQUIREMENTS (Does Not Apply)

CHANGES TO CONDITIONS OF THE CONTRACT (Does Not Apply)

CHANGES TO SPECIFICATIONS

- <u>ADD 1-1</u> <u>SECTION 033000 CAST-IN-PLACE-CONCRETE:</u> Revised Specification Section attached.
- <u>ADD 1-2</u> <u>SECTION 042200 UNIT MASONRY:</u> Revised Specification Section attached.
- <u>ADD 1-3</u> <u>SECTION 044313.13 ANCHORED STONE MASONRY VENEER:</u> Revised Specification Section attached.
- <u>ADD 1-4</u> <u>SECTION 057300 DECORATIVE METAL RAILINGS SITE:</u> Revised Specification Section attached.
- ADD 1-5 <u>SECTION 221100 WATER DISTRIBUTION PIPING AND SPECIALTIES</u>: Added PRZ, PRV, and YH to scope of Work.

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<u>ADD 1-6</u>	<u>SECTION 271100 – TELECOMMUNICATIONS EQUIPMENT ROOM FITTINGS:</u> Revised as follows:	
	A.	Clause 2.4.B – Swing Wall Rack: Model and accessories changed to 35U.
	В.	Clause 2.8 B.1 – Delete scope for UPS, it will be furnished and installed by City of Lee's Summit.
<u>ADD 1-7</u>	SEC	<u> FION 27130 – COMMUNICATION BACKBONE CABLING:</u> Revised as follows:
	A.	Deleted section for multi-mode cables.
	В.	Revised Specification for single-mode fiber-optic cable (clause 2.2.C.) copied from Lee's Summit Specification Section 2.
<u>ADD 1-8</u>	SECTION 321313 – CONCRETE PAVING: Revised Specification Section attached.	
<u>ADD 1-9</u>	<u>SECTION 321316 – DECORATIVE CONCRETE PAVING:</u> Revised Specification Section attached.	
<u>ADD 1-10</u>	<u>SECTION 321373 – CONCRETE PAVING JOINT SEALANTS:</u> Revised Specification Section attached.	
<u>ADD 1-11</u>	SECTION 321400 – UNIT PAVING: Revised Specification Section attached.	
<u>ADD 1-12</u>	<u>SECTION 321813 – SYNTHETIC TURF SYSTEM SURFACING:</u> Revised Specification Section attached.	
<u>ADD 1-13</u>	<u>SECTION 321823 – SYNTHETIC TURF SUBSURFACE AND DRAINAGE SYSTEM:</u> Revised Specification Section attached.	
<u>ADD 1-14</u>	SECTION 323300 – SITE FURNISHINGS: Revised Specification Section attached.	
<u>ADD 1-15</u>	SECTION 328400 – PLANTING IRRIGATION: Revised Specification Section attached.	
<u>ADD 1-16</u>	SECTION 329200 – TURF AND GRASSES: Revised Specification Section attached.	
<u>ADD 1-17</u>	SECTION 329300 – PLANTS: Revised Specification Section attached.	
		CHANGES TO DRAWINGS

GENERAL

- <u>ADD 1-18</u> <u>SHEET G-001 COVER SHEET</u>: Revised as follows:
 - A. Changed Note 20 under the General Notes per comment made in BlueBeam Session by Nikia Chapman-Freiberger.

B. Updated Sheet Index to reflect those Sheets as part of this Revision 1.

<u>ADD 1-19</u> <u>SHEET G-101 – CODE FOOTPRINT PLAN</u>: Revised as follows:

- A. Fire Flow Requirements have been updated per Fire Plan Correction Comment 2.
- B. Occupant load has been recalculated per Fire Plan Correction Comment 8.
- C. Occupant Load at Egress Exits have been recalculated.
- D. Plumbing fixture counts have been updated per new Occupant Load.
- E. Hatch Legend for Occupancy Type has been added.

CIVIL

- <u>ADD 1-20</u> <u>SHEET COVER SHEET:</u> Has been updated per City comments.
- <u>ADD 1-21</u> <u>SHEETS 001 to 003:</u> Sheets have been updated per City comments and final material selections.
- <u>ADD 1-22</u> <u>SHEETS L100 to L102</u>: Sheets have been updated per City comments.
- <u>ADD 1-23</u> <u>SHEETS L200 to L219:</u> Sheets have been updated per City comments, AT&T shed removal, final material selections, labels and dimensions added.
- <u>ADD 1-24</u> <u>SHEETS C100 to C106:</u> Sheets have been updated per City comments and AT&T shed removal.
- <u>ADD 1-25</u> <u>SHEET C200:</u> Sheet has been updated per City comments and AT&T shed removal.
- <u>ADD 1-26</u> <u>SHEETS C300 to C322:</u> Sheets have been updated per City comments, AT&T shed removal, and Farmers Market building coordination.
- <u>ADD 1-27</u> <u>SHEET C400:</u> Sheets have been updated per City comments, AT&T shed removal, and Farmers Market building coordination.
- <u>ADD 1-28</u> <u>SHEETS C500 to C511:</u> Sheets have been updated per City comments and AT&T shed removal.
- <u>ADD 1-29</u> <u>SHEETS L300 to L321:</u> Sheets have been updated per City comments, AT&T shed removal, and final material updates.
- <u>ADD 1-30</u> <u>SHEETS L400 to L490:</u> Sheets have been updated per City comments, AT&T shed removal, and final material updates.

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- ADD 1-31 SHEETS L500 to L591: Sheets have been updated per Site Plan updates.
- <u>ADD 1-32</u> <u>SHEETS E000 to E401:</u> Sheets have been updated per City comments, AT&T shed removal, and Site Plan updates.

STRUCTURAL

- ADD 1-33 SHEET S-101 FOUNDATION PLAN: Revised as follows:
 - A. Added locations where top of slab needs to be recessed for walk-off mats.
 - B. Updated location of doorway in concrete masonry unit (CMU) wall between storage and back of house.
 - C. Added CMU walls and footings for transformer enclosure.
 - D. Added elevation of CMU wall along gridline 2.
- <u>ADD 1-34</u> <u>SHEET S-106 CEILING FRAMING PLAN:</u> Added elevation of CMU wall along Gridline 2.
- <u>ADD 1-35</u> <u>SHEET S-111 LOWER ROOF FRAMING PLAN:</u> Revised as follows:
 - A. Updated beam size along Gridline C.2 to eliminate conflict with mechanical ductwork.
 - B. Added elevation of CMU wall along Gridline 2.
- ADD 1-36 <u>SHEET S-121 UPPER ROOF FRAMING PLAN:</u> Added elevation of CMU wall along Gridline 2.
- ADD 1-37 <u>SHEET S-202 BRACED FRAME ELEVATION AND DETAILS:</u> Added new Detail A4: CMU ELEVATION ALONG GRIDLINE 2.
- <u>ADD 1-38</u> <u>SHEET S-301 TYPICAL DETAILS:</u> Revised as follows:
 - A. Updated name of Detail A6.
 - B. Added Detail C6 for typical CMU enclosure walls.
 - C. Added Detail D6 for vertical sleeves through foundations.
- <u>ADD 1-39</u> <u>SHEET S-302 TYPICAL DETAILS:</u> Added Detail E3 for slab recess at walk-off mats.
- <u>ADD 1-40</u> <u>SHEET S-311 FOUNDATION SECTIONS:</u> Updated Detail C5 to include vertical sleeve for roof drain.

<u>ADD 1-41</u> <u>SHEET S-321 – ROOF FRAMING SECTIONS:</u> Updated beam size in Detail A5.

<u>ADD 1-42</u> <u>SHEET S-322 – ROOF FRAMING SECTIONS:</u> Revised as follows:

- A. Updated Detail A3 to include closure plate on end of joists.
- B. Updated Detail A5 to include closure late on end of joists.
- <u>ADD 1-43</u> <u>SHEET S-323 ROOF FRAMING SECTIONS:</u> Revised detail numbers to be the correct scheme.

ARCHITECTURAL

<u>ADD 1-44</u> <u>SHEET A-100 – CONTEXTUAL FLOOR PLAN:</u> Revised as follows:

- A. Added Dumpster Enclosure and callout.
- B. Added room tag for IT.

<u>ADD 1-45</u> <u>SHEET A-101 – ARCHITECTURAL FLOOR PLAN:</u> Revised as follows:

- A. Modified partition tags on Floor Plan.
- B. Added walk-off mats to Low Roof Plan.
- C. Added a Basis-of-Design Note for roof hatch and guard around hatch per Building Plan Comments 5 and 6.
- D. Adjusted cricket per roof drain and overflow drain on Low Roof Plan.
- <u>ADD 1-46</u> <u>SHEET A-111 CEILING PLAN:</u> Recessed can lights have been added in low ceiling of Farmers Market. (Referenced Electrical)
- <u>ADD 1-47</u> <u>SHEET A-121 ROOF PLAN:</u> Revised as follows:
 - A. Added walk-off mats to Low Roof.
 - B. Added a Basis-of-Design Note for roof hatch and guard around hatch per Building Plan Comment 5 and 6.
 - C. Adjusted cricket per roof drain and overflow drain on low roof.

<u>ADD 1-48</u> <u>SHEET A-201 – EXTERIOR ELEVATIONS:</u> Revised as follows:

A. Added address signage callout per Fire-Plan Correction Comment 4.

- B. Added horizontal dimensions to brick wall insets.
- C. Added downspouts from clerestory roof.
- D. Added a Basis of Design for the mechanical screen.
- E. Specified size of gutter in the keynotes.
- F. Added dashed line of mechanical units behind mechanical screen per Final Development comment.
- G. Added Keynote 22 for mechanical duct.

<u>ADD 1-49</u> <u>SHEET A-202 – EXTERIOR ELEVATIONS:</u> Revised as follows:

- A. Added downspouts from clerestory.
- B. Modified Keynotes.
- <u>ADD 1-50</u> <u>SHEET A-311 WALL SECTIONS:</u> Modified parapet cap note.
- <u>ADD 1-51</u> <u>SHEET A-312 WALL SECTIONS:</u> Added additional framing above interior storefront.
- <u>ADD 1-52</u> <u>SHEET A-313 WALL SECTIONS:</u> Added additional framing above interior storefront.
- <u>ADD 1-53</u> <u>SHEET A-401 ENLARGED FLOOR PLANS</u>: Added note to provide backing per manufacturer's recommendations for the bathroom sinks.
- <u>ADD 1-54</u> <u>SHEET A-501 PLAN DETAILS:</u> Revised as follows:
 - A. Modified Plan Notes on Detail 1.
 - B. Added blocking at storefront on Detail 2.
 - C. Modified rigid insulation on Detail 2.
 - D. Added break metal at opening on Detail 4.
 - E. Modified location of air weather barrier on Detail 5.

<u>ADD 1-55</u> <u>SHEET A-502 - SERVICE ENCLOSURE DETAILS</u>: Revised as follows:

- A. Added detail callouts to front elevation.
- B. Modified notes on section.

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- ADD 1-56 SHEET A-503 TRASH ENCLOSURE PLAN AND ELEVATIONS: New Sheet added to set.
- ADD 1-57 SHEET A-521 ROOF DETAILS: Revised as follows:
 - A. Modified location of air weather barrier.
 - B. Removed blocking on Details 1, 3, 4, 6, and 8.
 - C. Added blocking at opening on Detail 2.
 - D. Extended flashing to sheathing on Detail 2.

<u>ADD 1-58</u> <u>SHEET A-522 - ROOF DETAILS:</u> Revised as follows:

- A. Modified location of air weather barrier.
- B. Removed blocking on Details 4 and 5.
- C. Added tongue to scupper Detail.
- D. Added new pilaster cap detail.
- <u>ADD 1-59</u> <u>SHEET A-531 FOUNDATION DETAILS:</u> Revised as follows:
 - A. Modified location of vapor barrier.
 - B. Modified location of air barrier.
- <u>ADD 1-60</u> <u>SHEET A-541 DOOR/STOREFONT DETAILS:</u> Revised as follows:
 - A. Modified location of storefront within walls and added dimensions for reference.
 - B. Modified location of vapor barrier in Sill Detail.

<u>ADD 1-61</u> <u>SHEET A-542 - DOOR/STOREFONT DETAILS:</u> Revised as follows:

- A. Added blocking at Storefront Jamb Detail 4.
- B. Modified Detail 5 per structural beam location.
- C. Added brake metal at opening on Detail 6.

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<u>ADD 1-62</u> <u>SHEET A-601 - PARTITION TYPES:</u> Revised as follows:

- A. Took off fire-rating at Partition 3.
- B. Adjusted Partition Types 3 and 4 for additional height variations.
- C. Modified top of column Details A and B.
- <u>ADD 1-63</u> <u>SHEET A-602 DOOR AND STOREFRONT SCHEDULE:</u> Called out solid panel between double doors on Details SF9 and SF11.

INTERIORS

ADD 1-64 SHEET I-101 - INTERIOR DESIGN PLANS & GENERAL NOTES: Revised as follows:

- A. D1 Overall Finish Plan:
 - 1. Added dimension at Vestibule 100 where entry mat install direction changes due to path of travel.
 - 2. Adjusted viewport to include transformer enclosure.
- B. A1 SW Restroom Finish Plan: Adjusted wall depth at lavatories and added dimension.
- C. A3 NE Restroom Finish Plan: Adjusted wall depth at lavatories and added dimension.

<u>ADD 1-65</u> <u>SHEET I-201 - INTERIOR DESIGN DETAILS & ELEVATIONS:</u> Revised as follows:

- A. E5 Typical ADA Toilet Elevation B: Adjusted dimension of grab bar location.
- <u>ADD 1-66</u> <u>SHEET I-301 LEGENDS & SCHEDULES:</u> Revised as follows:
 - A. D2 Plaque Signage, Typical: Added plaque sign installation detail.
 - B. Room Finish Schedule: Added RB2 wall base to Catering Kitchen finishes.
 - C. Plumbing & Toilet Accessory Schedule:
 - 1. Updated lavatory plumbing fixtures to Rush Street style (Fixtures 07 faucet, 08 soap dispenser, and 09 hand dryer).

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- <u>ADD 1-67</u> <u>NARRATIVE FROM CONSULTANTS:</u> Please see attached narrative from Henderson Engineers for the following disciplines:
 - A. Audio/Video
 - B. Mechanical
 - C. Electrical
 - D. Plumbing
 - E. Fire Protection
 - F. Telecommunications
 - G. Security

END OF ADDENDUM 1



ADDENDUM NO 01

DATE 12/22/23

ISSUED BY Henderson Engineers, Inc. 1801 Main St. Kansas City, MO 64108 **ISSUED FOR** Lee's Summit Downtown Market Plaza

NOTICE TO ALL BIDDERS FOR THE

Lee's Summit Downtown Market Plaza Lee's Summit, MO

You are instructed to read and to note the following described changes, corrections, clarifications, omissions, deletions, additions, approvals, and statements pertinent to the Contract Bid and Construction Documents.

This addendum is part of the Contract Bid and Construction Documents and shall govern in the performance of the Work.

AUDIO-VIDEO

TA-201 AUDIO-VIDEO RCP

 A. Added one 1.5" conduit with bushings as indicated on drawing.

MECHANICAL

1. Shifted ductwork in Vestibule 100 plan left to avoid the wall conflict.

ELECTRICAL

- 1. E-100 ELECTRICAL SITE PLAN
 - A. Adjust utility transformer, meter, and CT cabinet location.
- 2. E-101 LIGHTING PLAN
 - A. Shift (1) type L9 fixture in lobby to line up with Architectural ceiling slots.
 - B. Add exterior building mounted fixtures type L7 and L8 to emergency lighting inverter for all egress exits.
 - C. Relocate lighting controls in Mech/Elec room for civil/landscape light to accommodate for panel L2 second section.
- 3. E-201 POWER PLAN
 - A. Relocate card reader door access from IT 118 to Storage 111 door.
 - B. Revise panelboard L2 to be a two-section panelboard.
 - C. Revise circuit numbers in rooms 100 and 101 for circuit changes in panelboard L2.
- 4. E-202 POWER ROOF PLAN
 - A. Revise circuit numbers for circuit changes in panelboard L2.

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- 5. E-400 ENLARGED PLANS
 - A. Add trash compactor power connection and maintenance receptacle at trash compactor enclosure.
 - B. Revise canopy lighting circuit number.
- 6. E-500 ELECTRICAL ONE-LINE DIAGRAM
 - A. Add trash compactor power connection in distribution board DP.
- 7. E-501 ELECTRICAL SCHEDULES
 - A. Revise exterior site lighting and receptacle circuits in panelboard L2 to coordinate with Civil plans.
 - B. Revise panelboard L2 to be a two-section panelboard.
 - C. Provide circuit 20 in panelboard L1 for trash compactor receptacle.
 - D. Revise panelboard L2 circuits 40,42,44,46 to 51,53,55,57 respectively for coordination with Civil required circuits.
 - E. Add irrigation controller circuit to coordinate with Civil plans.

PLUMBING

- 1. P-101
 - A. Added 3" backflow preventer and associated domestic water piping and accessories in STORAGE 111.
 - B. Added PRV bypass assembly in STORAGE 111.
 - C. Added 4" floor drain and associated waste and vent piping in STORAGE 111.
 - D. Added details #2, #3 & #4.
 - E. Added Trash Enclosure floor plan (detail #5), as well as a yard hydrant and associated water piping.
 - F. Relocated gas meter and re-routed associated gas piping.
- 2. P-102
 - A. Added 2" VTR to serve floor drain.
- 3. P-201
 - A. Rotated wall cleanout (WCO) in CORRIDOR 112.
- 4. P-301
 - A. Updated domestic water isometric.
- 5. P-302
 - A. Updated domestic waste and vent isometric.
- 6. P-303
 - A. Updated gas isometric.
- 7. P-401
 - A. Added 3" RPZ-1 to fixture schedule.
 - B. Added FD-2 to fixture schedule.
 - C. Added PRV-1 to fixture schedule.
 - D. Added YH-1 to fixture schedule.
- 8. Updated section 221100 Water Distribution Piping and Specialties Specifications for the addition of RPZ, PRV and YH to scope of work.

FIRE PROTECTION

1. FP-000 FIRE GENERAL NOTES & LEGEND

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- A. Updated FA Riser to reflect voice alarm system.
- B. Added HVLS fan shutdown to sequence of operations.
- 2. FP-101 FIRE PROTECTION PLAN
 - A. Relocated knox box to be 6' AFF above the FDC
 - B. Updated FACP layout to reflect voice alarm system.
 - C. Added Control Modules to HVLS fans.
 - D. Updated keynote FP5 to reflect voice alarm system.
 - E. Updated keynote FP7 for added clarify.
 - F. Added keynote FP12 for HVLS fan connection to FA system.

TELECOM

1. TN000

A. Telecom responsibility matrix: UPS to be furnished /installed by Owner, removed from GC scope.

- 2. TN001
 - A. Add structured cabling for (3) canopy mounted cameras.
 - B. Added keynotes T35 & T36.
- 3. TN101
 - A. Relocation of telecom equipment in mech/elec room 109.
- 4. TN201
 - A. Revised number of data cables for MDF.
- 5. TN401-View 1
 - A. Delete the 12 strand MMF between MDF and IDF, 24 strand Single-Mode Fiber coming from City Hall to be spliced in IDF and will continue to MDF.
- 6. Specification- Section 271300
 - A. Deleted section for multi-mode cables.
 - B. Revised specification for single mode fiber optic cable (clause 2.2.C) copied from LEE Summit specification Section 2
- 7. Specification- Section 271100
 - A. Clause 2.4.B -Swing Wall rack: model and accessories changed to 35U.
 - B. Clause 2.8 B.1 Delete scope for UPS, it will be furnished and Installed by City of Lees Summit

SECURITY

- 1. TY101
 - A. Relocate card reader to storage door.

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete standards.
 - 2. Concrete materials.
 - 3. Admixtures.
 - 4. Curing materials.
 - 5. Accessories.
 - 6. Repair materials.
 - 7. Concrete mixture materials.
 - 8. Concrete mixture class types.
 - 9. Concrete mixing.
- B. Related Requirements:
 - 1. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
 - 2. Section 321313 "Concrete Paving" for concrete pavement and walks.
 - 3. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.2 DEFINITIONS

- A. Cementitious Materials: Portland cement or blended hydraulic cement alone or in combination with one or more of the following:
 - 1. Fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cementitious Materials (w/cm) Ratio: The ratio by weight of mixing water to cementitious materials.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 - 1. Installer: Include copies of applicable ACI certificates.
 - 2. Testing Agency: Include documentation indicating compliance with ASTM E329 or ASTM C1077 and copies of applicable ACI certificates for testing technicians or ACI Concrete Construction Special Inspector MH, ASCC.
- B. Material Certificates.
- C. Material Test Reports.
- D. Preconstruction Test Reports: For each mix design.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.
 - 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer's production facilities and delivery vehicles certified in accordance with NRMCA's certification requirements or equivalent approval by a State DOT.
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing that performs duties on behalf of the Architect/Engineer.
 - 1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Level 1. Testing agency laboratory supervisor tests to be an ACI-certified Concrete Laboratory Testing Technician, Level 2.
- D. Field Quality-Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests on plastic concrete properties are to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with policies from ACI CPP 610.1 or an equivalent certification program.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - A. Comply with ASTM C94/C94M and ACI 301.

1.8 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 as follows:
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When air temperature has fallen to, or is expected to fall below 40 deg F during the protection period, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1

PART 2 - PRODUCTS

- 2.1 CONCRETE STANDARDS
 - A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.

- 2. Obtain each type of admixture from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C150, Type I/II, gray.
- C. Normal-Weight Aggregates:
 - 1. Coarse Aggregate: ASTM C33, Class 3S
 - 2. Maximum Coarse-Aggregate Size: 1 inch
 - 3. Fine Aggregate: ASTM C33.
- 2.3 FORM-FACING MATERIALS
 - A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- 2.4 ADMIXTURES
 - A. Air-Entraining Admixture: ASTM C260.
 - B. Chemical Admixtures: Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.
 - 1. Water-Reducing Admixture: ASTM C494, Type A.
 - 2. Retarding Admixture: ASTM C494, Type B.
 - 3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
 - 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.
 - C. Mixing Water for Concrete Mixtures and Water Used to Make Ice: ASTM C1602. Include documentation of compliance with limits for alkalis, sulfates, chlorides, or solids content of mixing water from Table 2 in ASTM C1602.

2.5 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

C. Water: Potable water that does not cause staining of the surface.

2.6 ACCESSORIES

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

2.7 CONCRETE MIXTURE MATERIALS

- 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, in accordance with ACI 301.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete assigned to Exposure Class F3 as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

2.8 CONCRETE MIXTURE CLASS TYPES

- A. Class A: Normal-weight concrete used for footings, grade beams, and tie beams.
 - 1. Exposure Class: ACI 318, Class S3.
 - 2. Minimum Compressive Strength: 4500 psi psi strength at 28 days.
 - 3. Maximum w/cm Ratio: 0.45.
 - 4. Slump Limit: 4 inches, plus or minus 1 inch.
 - 5. Slump Flow Limit: 22 inches, plus or minus 1-1/2 inches
 - 6. Air Content:
 - a. Exposure Classes F2 and F3: 6.0 percent, plus or minus 1.5 percent at point of delivery.
 - 7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cementitious materials.
- B. Class J: Normal-weight concrete used for exterior retaining walls.
 - 1. Exposure Class: ACI 318 Class S3.
 - 2. Minimum Compressive Strength: 4500 psi at 90 days.
 - 3. Maximum w/cm Ratio: 0.45.
 - 4. Slump Limit: 4 inches, plus or minus 1 inch.
 - 5. Slump Flow Limit: 22 inches, plus or minus 1.5 inches.

- 6. Air Content:
 - a. Exposure Classes F2 and F3: 6.0 percent, plus or minus 1.5 percent at point of delivery for concrete.
- 7. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94 and furnish delivery ticket.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.

- 4. Security and protection for test samples and for testing and inspection equipment at Project site.
- 3.3 TOLERANCES
 - A. Comply with ACI 117.

3.4 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install reglets to receive waterproofing and through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.5 INSTALLATION OF CAST-IN-PLACE CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Water addition in transit or at the Project site must be in accordance with ASTM C94 and must not exceed the permitted amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

- a. Do not use vibrators to transport concrete inside forms.
- b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
- c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
- d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

3.6 INSTALLATION OF JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.
- D. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.7 APPLICATION OF FINISHING FORMED SURFACES

- A. As-Cast Surface Finishes:
 - 1. ACI 301 Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/4 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117, Class B.
 - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
 - 2. ACI 301 Surface Finish SF-3.0:
 - a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
 - b. Remove projections larger than 1/8 inch.
 - c. Patch tie holes.
 - d. Surface Tolerance: ACI 117 Class A.
 - e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- B. Rubbed Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
 - 1. Smooth-Rubbed Finish:
 - a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 - c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
 - d. Maintain required patterns or variances as shown on Drawings or to match mockups.

3.8 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

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

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

3.9 APPLICATION OF CONCRETE CURING

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - 1. Comply with ACI 301 for cold weather protection during curing.
 - 2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
 - 3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305R, before and during finishing operations.
- B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:
 - 1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
 - 2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
 - 3. If forms remain during curing period, moist cure after loosening forms.
 - 4. If removing forms before end of curing period, continue curing for remainder of curing period as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial application.
 - 2) Maintain continuity of coating and repair damage during curing period.

3.10 INSTALLATION OF JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month.

- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.11 INSTALLATION OF CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to meet specification requirements.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks in excess of 0.01 inch spalls, air bubbles exceeding surface finish limits, honeycombs, rock pockets, fins and other projections on the surface exceeding surface finish limits, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.
 - a. Limit cut depth to 3/4 inch.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and match surrounding surface.
 - 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance, as determined by Architect.
- D. Repairing Unformed Surfaces:

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

- c. Place patching mortar before bonding agent has dried.
- d. Compact patching mortar and finish to match adjacent concrete.
- e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 3.12 FIELD QUALITY CONTROL
 - A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
 - B. Delivery Tickets: comply with ASTM C94/C94M.
 - C. Inspections:
 - 1. Headed bolts and studs.
 - 2. Verification of use of required design mixture.
 - 3. Concrete placement, including conveying and depositing.
 - 4. Curing procedures and maintenance of curing temperature.
 - 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 - 6. Batch Plant Inspections: On a random basis, as determined by Architect.
 - D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. or fraction thereof.
 - a. When frequency of testing provides fewer than five compressivestrength tests for each concrete mixture, testing is to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C143/C143M:
 - a. One test at point of delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests as needed.
 - 3. Slump Flow: ASTM C1611/C1611M:

- a. One test at point of delivery for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
- b. Perform additional tests as needed.
- 4. Air Content: ASTM C231 pressure method, for normal-weight concrete; ASTM C173 volumetric method, for structural lightweight concrete.
 - a. One test for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
- 5. Concrete Temperature: ASTM C1064:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample when strength test specimens are cast.
- 6. Concrete Density: ASTM C138:
 - a. One test for each composite sample when strength test specimens are cast.
- 7. Unit Weight: ASTM C138 density of fresh structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture. The fresh density should be consistent with that associated with the equilibrium density within a tolerance of plus or minus 4 lb/ft.³.
- 8. Compression Test Specimens: ASTM C31:
 - a. Cast and standard cure two sets of four 6 inches by 12-inches or 4inch by 8-inch cylindrical specimens for each composite sample.
- 9. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of two standard cured specimens at seven days and one set of two specimens at 28 days.
 - b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
- 10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests of standard cured cylinders equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.

- 11. 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.
- 12. Additional Tests:
 - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.7.6.3.
- 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 do not comply with the Contract Documents.

3.13 PROTECTION

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

END OF SECTION

SECTION 042000 - UNIT MASONRY-OLSSON

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes unit masonry assemblies consisting of the following:
 - 1. Concrete masonry units.
 - 2. Face brick.

1.2 SUBMITTALS

- A. Product Data: For each masonry unit, accessory, and other manufactured product indicated.
- B. Shop Drawings: For masonry reinforcing bars; comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
- C. Samples: Showing the full range of colors and textures available for exposed masonry units and colored mortars.
- D. Material Test Reports: For each type of masonry unit, mortar, and grout required.
- E. Material Certificates: For each type of masonry unit required.

1.3 QUALITY ASSURANCE

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on each type of unit required per test method indicated.
 - 1. Clay Masonry Units: ASTM C 67.
 - 2. Concrete Masonry Units: ASTM C 140.
 - 3. Mortar: For properties per ASTM C 270.
 - 4. Grout: For compressive strength per ASTM C 1019.
- B. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.
- C. Mockups: Build sample panels for each type of exposed unit masonry assembly to verify selections made under sample Submittals and to demonstrate aesthetic effects.
 - 1. Build mockups in sizes approximately 48 inches long by 48 inches high by full thickness.

1.4 PROJECT CONDITIONS

- A. Cold-Weather Requirements: Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.
- B. Hot-Weather Requirements: When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products specified.
 - 2. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 COLORS AND TEXTURES

- A. Exposed Brick Units: Per plans.
- 2.3 MASONRY UNITS
 - A. Concrete Masonry Units: ASTM C 90.
 - 1. Provide shapes indicated.
 - 2. Weight Classification: Normal weight.
 - 3. Type: II, nonmoisture-controlled units.
 - B. Brick, General:
 - 1. Provide units without cores or frogs and with exposed surfaces finished for ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces.
 - 2. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
 - C. Face Brick: ASTM C 216, Grade SW, Type FBS.
 - 1. Unit Compressive Strength: 3000-psi minimum, average net-area compressive strength.
 - 2. Initial Rate of Absorption: Less than 20 g/30 sq. in. per minute when tested per ASTM C 67.

- 3. Efflorescence: When tested per ASTM C 67 and brick is rated "not effloresced."
- 4. Size: Manufactured to the following actual dimensions:
 - a. Norman: 3-5/8 inches wide by 2-1/4 inches high by 11-5/8 inches long.
- 5. Approved manufacturers
 - a. Hebron Brick
 - b. Glen-Gery
 - c. Acme Brick Company
 - d. Or, approved equal

2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for coldweather construction.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Mortar Cement: ASTM C 1329.
 - 1. Products:
 - a. Blue Circle Cement; Magnolia Superbond Mortar Cement.
 - b. Lafarge Corporation; Lafarge Mortar Cement.
- D. Pigmented Mortar: Colored cement or cement-lime formulation as required to produce the color indicated.
 - 1. Colored Portland Cement-Lime Mix:
 - a. Products:
 - 1) Blue Circle Cement; Eaglebond.
 - 2) Glen-Gery Corporation; Color Mortar Blend.
 - 3) Holnam, Inc.; Rainbow Mortamix Custom Color Cement/Lime.
 - 4) Lafarge Corporation; Centurion Colorbond PL.
 - 5) Lehigh Portland Cement Co.; Lehigh Custom Color Portland/Lime.
 - 6) Riverton Corporation (The); Riverton Portland Cement Lime Custom Color.
- E. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
 - 1. Colored-Mortar Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.
- F. Aggregate for Grout: ASTM C 404.
- G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.
 - 1. Products:

- a. Davis Colors; True Tone Mortar Colors.
- b. Lafarge Corporation; Centurion Pigments.
- c. Solomon Grind-Chem Services, Inc.; SGS Mortar Colors.
- H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.
 - 1. Products:
 - a. Euclid Chemical Co.; Accelguard 80.
 - b. Grace, W. R. & Co., Construction Products Division; Morseled.
 - c. Sonneborn, Div. of ChemRex, Inc.; Trimix-NCA.
- I. Water: Potable.

2.5 REINFORCING

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M; ASTM A 616/A 616M, including Supplement 1; or ASTM A 617/A 617M, Grade 60.
- B. Masonry Joint Reinforcement: ASTM A 951; mill galvanized, carbon-steel wire for interior walls and hot-dip galvanized, carbon-steel wire for exterior walls.
 - 1. Single-Wythe Masonry: Use either ladder or truss type with single pair of side rods and cross rods spaced not more than 16 inches o.c.
 - 2. Multiwythe Masonry: Use ladder type with perpendicular cross rods spaced not more than 16 inches o.c. and 1 side rod for each face shell of hollow masonry units more than 4 inches in width, plus 1 side rod for each wythe of masonry 4 inches or less in width.

2.6 TIES AND ANCHORS

- A. Materials, General: As follows, unless otherwise indicated:
 - 1. Galvanized Carbon-Steel Wire: ASTM A 82; with ASTM A 153, Class B-2 coating for exterior walls and Class 1 coating for interior walls.
 - 2. Galvanized Steel Sheet: ASTM A 366/A 366M cold-rolled, carbon-steel sheet hotdip galvanized after fabrication to comply with ASTM A 153, at exterior walls; and ASTM A 653/A 653M, G60, commercial-quality, steel sheet zinc coated by hot-dip process on continuous lines before fabrication at interior walls.
- B. Bent Wire Ties: Rectangular units with closed ends and not less than 4 inches wide, made from 3/16-inch- diameter, galvanized steel wire.
- C. Anchors for Connecting to Concrete: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to wall.

- 1. Anchor Section: Dovetail anchor section formed from 0.0528-inch- thick, galvanized steel sheet.
- 2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.1875-inch- diameter, galvanized steel wire.

2.7 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing and Accessories: Fabricated to complying with requirements specified in Division 7 Section "Sheet Metal Flashing and Trim."
 - 1. Material: copper, 10-oz./sq. ft. weight or 0.0135 inch thick for fully concealed flashing; 16-oz./sq. ft. weight or 0.0216 inch thick elsewhere.
- B. Contractor's Option for Concealed Flashing: For flashing partly exposed to the exterior, use metal flashing specified above. For flashing not exposed to the exterior, use the following, unless otherwise indicated:
 - 1. Copper-Laminated Flashing: Manufacturer's standard laminated flashing consisting of 5-oz./sq. ft. sheet copper bonded with asphalt between 2 layers of glass-fiber cloth.
 - a. Products:
 - 1) Advanced Building Products, Inc.; Copper Fabric Flashing.
 - 2) AFCO Products, Inc.; Copper Fabric.
 - 3) Hohmann & Barnard, Inc.; H & B C-Fab Flashing.
 - 4) Phoenix Building Products; Type FCC-Fabric Covered Copper.
 - 5) Polytite Manufacturing Corp.; Copper Fabric Flashing.
 - 6) Sandell Manufacturing Co., Inc.; Copper Fabric Flashing.
 - 7) York Manufacturing, Inc.; York Copper Fabric Flashing.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene.
- B. Preformed Control-Joint Gaskets: Designed to fit standard sash block and to maintain lateral stability in masonry wall. Made from PVC complying with ASTM D 2287, Type PVC-65406.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Wicking Material: Cotton or polyester rope, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity between wythes.
- 2.9 MASONRY CLEANERS

- A. Job-Mixed Detergent Solution: Solution of 1/2-cup dry measure tetrasodium polyphosphate and 1/2-cup dry measure laundry detergent dissolved in 1 gal. of water.
- B. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

2.10 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, unless otherwise indicated. Do not use calcium chloride in mortar or grout.
- B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Property Specification.
 - 1. Extended-Life Mortar for Unit Masonry: Mortar complying with ASTM C 1142 may be used instead of mortar specified above, at Contractor's option.
 - 2. Limit cementitious materials in mortar to portland cement, mortar cement, and lime.
 - 3. For masonry below grade, in contact with earth, and where indicated, use Type S.
 - 4. For exterior, above-grade, load-bearing and non-load-bearing walls, and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N or RN.
- D. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required. Limit pigments to the following percentages of cement content by weight:
 - 1. For portland cement-lime mortar, not more than 10 percent.
- E. Grout for Unit Masonry: Comply with ASTM C 476.
 - 1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
 - 2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

2.11 SOURCE QUALITY CONTROL

- A. Owner will engage a qualified independent testing agency to perform source qualitycontrol testing indicated below.
 - 1. Payment for these services will be made by Owner.
 - 2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.
- B. Brick Tests: For each type and grade of brick indicated, units will be tested according to ASTM C 67.

C. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cut masonry units with motor-driven saws. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
- C. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.
- D. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:
 - 1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.
 - 2. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

3.2 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Lay exposed masonry in bond pattern indicated; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.
- D. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

3.3 MORTAR BEDDING AND JOINTING

A. Lay hollow masonry units as follows:

- 1. With full mortar coverage on horizontal and vertical face shells.
- 2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
- 3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.

3.4 CAVITIES

- A. Keep cavities clean of mortar droppings and other materials during construction.
 - 1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.

3.5 MASONRY JOINT REINFORCEMENT

- A. Provide continuous masonry joint reinforcement as indicated. Install with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
- B. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections.

3.6 ANCHORING MASONRY

- A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:
 - 1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated.
 - 2. Anchor masonry to structural members with flexible anchors embedded in masonry joints and attached to structure.
- B. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
 - 1. Fasten each anchor section to concrete and masonry backup with two metal fasteners of type indicated.
 - 2. Embed tie sections in masonry joints.
 - 3. Space anchors not more than 16 inches o.c. vertically and 24 inches o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.7 FLASHING, WEEP HOLES, AND VENTS

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
 - 1. Extend flashing 4 inches at ends and turn flashing up not less than 2 inches to form a pan.
 - 2. Install metal drip edges beneath flashing at exterior face of wall. Stop flashing 1/2 inch back from outside face of wall and adhere flashing to top of metal drip edge.
 - 3. Install metal flashing termination beneath flashing at exterior face of wall. Stop flashing 1/2 inch back from outside face of wall and adhere flashing to top of metal flashing termination.
- B. Install weep holes in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing.
 - 1. Space weep holes 16 inches o.c.
 - 2. Trim wicking material used in weep holes flush with outside face of wall after mortar has set.

3.8 FIELD QUALITY CONTROL

- A. Owner will engage a qualified independent testing agency to perform field quality-control testing indicated below. Payment for these services will be made by Owner.
 - 1. Testing Frequency: Tests and Evaluations listed in these subparagraphs will be performed during construction for each 500 sq. ft. of wall area or portion thereof.
 - 2. Mortar: Properties will be tested per ASTM C 780.
 - 3. Grout: Sampled and tested for compressive strength per ASTM C 1019.
 - 4. Brick Tests: For each type and grade of brick indicated, units will be tested according to ASTM C 67.
 - 5. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

3.9 CLEANING

- A. Clean unit masonry by dry brushing to remove mortar fins and smears before tooling joints, as work progresses.
- B. After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
 - 2. Protect adjacent surfaces from contact with cleaner.
 - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
 - 4. Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.
 - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2 applicable to type of stain on exposed surfaces.

3.10 MASONRY WASTE DISPOSAL

- A. Masonry Waste Disposal: Dispose of clean masonry waste, including broken masonry units, waste mortar, and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
 - 1. Do not dispose of masonry waste as fill within 18 inches of finished grade.
 - 2. Remove excess, clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 044313.13 - ANCHORED STONE MASONRY VENEER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Stone masonry anchored to concrete backup.
 - 2. Stone masonry anchored to unit masonry backup.
 - 3. Stone cap.
- B. Products Installed but Not Furnished under This Section Include:
 - 1. Steel lintels in unit masonry.
 - 2. Steel shelf angles for supporting unit masonry.
- C. Related Requirements:
 - 1. Section 042000 "Unit Masonry" for concealed flashing, horizontal joint reinforcement, and veneer anchors.
- 1.2 ACTION SUBMITTALS
 - A. Product Data: For each variety of stone, stone accessory, and manufactured product.
 - B. Samples for Verification:
 - 1. For each stone type indicated. Include at least four Samples in each set and show the full range of color and other visual characteristics in completed Work.
 - 2. For each color of mortar required.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, supply sources, and other information as required to identify materials used. Include mix proportions for mortar and source of aggregates.

- 1. Neither receipt of list nor approval of mockups constitutes approval of deviations from the Contract Documents contained in mockups unless Landscape Architect approves such deviations in writing.
- C. Material Test Reports:
 - 1. Stone Test Reports: For each stone variety proposed for use on Project, by a qualified testing agency, indicating compliance with required physical properties, other than abrasion resistance, according to referenced ASTM standards. Base reports on testing done within previous three years.
 - 2. Sealant Compatibility and Adhesion Test Report: From sealant manufacturer indicating that sealants will not stain or damage stone. Include interpretation of test results and recommendations for primers and substrate preparation needed for adhesion.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs experienced stonemasons and stone fitters.
- B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Build mockups for each type of stone masonry in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup wythes and accessories.
 - a. Include stone cap at top of mockup.
 - b. Include a sealant-filled joint at least 16 inches long in mockup.
 - c. Include through-wall flashing installed for a 24-inch length in corner of mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit stone masonry above half of flashing).
 - 3. Protect accepted mockups from the elements with weather-resistant membrane.
 - 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

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

- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, in a dry location, or in covered weatherproof dispensing silos.
- D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.6 FIELD CONDITIONS

- A. Protection of Stone Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed stone masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- B. Stain Prevention: Immediately remove mortar and soil to prevent them from staining stone masonry face.
 - 1. Protect base of walls from rain-splashed mud and mortar splatter using coverings spread on the ground and over the wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at end of each day to prevent rain from splashing mortar and dirt on completed stone masonry.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace stone masonry damaged by frost or freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

1.7 COORDINATION

A. Advise installers of adjacent Work about specific requirements for placement of reinforcement, veneer anchors, flashing, and similar items to be built into stone masonry.

B. Coordinate locations of dovetail slots installed in concrete that are to receive stone anchors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Stone: Obtain each variety of stone, from single quarry with resources to provide materials of consistent quality in appearance and physical properties.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of uniform quality for each cementitious component from single manufacturer and each aggregate from single source or producer.
- C. Varieties and Sources: Subject to compliance with requirements, provide stone of varieties and from sources complying with Section 044200 "Exterior Stone Cladding."

2.2 LIMESTONE

- A. Material Standard: Comply with ASTM C568/C568M.
 - Classification: I Low Density II Medium Density II Medium Density, except as follows: absorption, 5 percent by weight maximum; density, 150 lb/cu. ft. minimum; compressive strength, 8000 psi minimum; and modulus of rupture 800 psi minimum III High Density.
- B. Description: Dolomitic Oolitic Shell limestone.
- C. Varieties and Sources: Indiana limestone quarried in Lawrence, Monroe, or Owen Counties, Indiana.
 - 1. Indiana Limestone Grade and Color: Select, buff Select, gray Standard, buff Standard, gray Rustic, buff Rustic, gray Variegated, according to grade and color classification established by ILI.
- D. Match Landscape Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II, except Type III may be used for cold-weather construction; natural color or white cement may be used as required to produce mortar color indicated.

- 1. Low-Alkali Cement: Not more than 0.60 percent total alkali when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Holcim (US) Inc.
 - b. Lafarge North America Inc.
 - c. Lehigh Hanson; HeidelbergCement Group.
 - d. Mutual Materials Co.
- D. Mortar Cement: ASTM C1329/C1329M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Lafarge North America Inc.
- E. Masonry Cement: ASTM C91/C91M.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cemex S.A.B. de C.V.
 - b. Holcim (US) Inc.
 - c. Lafarge North America Inc.
 - d. Lehigh Hanson; HeidelbergCement Group.
 - e. National Cement Company, Inc.
- F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C979/C979M. Use only pigments with a record of satisfactory performance in stone masonry mortar.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Davis Colors.
 - b. Lanxess Corporation.
 - c. Solomon Colors, Inc.
- G. Colored Portland Cement-Lime Mix: Packaged blend of portland cement, hydrated lime, and mortar pigments. Mix produces color indicated or, if not indicated, as selected from manufacturer's standard colors. Pigments do not exceed 10 percent of portland cement by weight.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Holcim (US) Inc.
 - b. Lafarge North America Inc.
 - c. Lehigh Hanson; HeidelbergCement Group.
 - d. Mutual Materials Co.
- H. Colored Masonry Cement Mix: Packaged blend of masonry cement and mortar pigments. Mix produces color indicated or, if not indicated, as selected from manufacturer's standard colors. Pigments do not exceed 5 percent of masonry cement by weight.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cemex S.A.B. de C.V.
 - b. Essroc.
 - c. Holcim (US) Inc.
 - d. Lafarge North America Inc.
 - e. Lehigh Hanson; HeidelbergCement Group.
 - f. National Cement Company, Inc.
- I. Aggregate: ASTM C144 and as follows:
 - 1. For pointing mortar, use aggregate graded with 100 percent passing No. 16 sieve.
 - 2. White Aggregates: Natural white sand or ground white stone.
 - 3. Colored Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.
 - a. Match Architect's sample.
- J. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Euclid Chemical Company (The); an RPM company.
 - b. GCP Applied Technologies Inc.
 - c. Sonneborn.
- K. Water: Potable.
- 2.4 VENEER ANCHORS
 - A. Materials:

Final Development Plans

- 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A1064/A1064M; with ASTM A153/A153M, Class B-2.
- 2. Stainless Steel Wire: ASTM A580/A580M, Type 304 Type 316.
- 3. Hot-Dip Galvanized-Steel Sheet: ASTM A1008/A1008M, cold-rolled, carbon-steel sheet, hot-dip galvanized after fabrication to comply with ASTM A153/A153M, Class B-2.
- 4. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, Type 304 Type 316.
- B. Size: Sufficient to extend at least halfway, but not less than 1-1/2 inches, through stone masonry and with at least a 5/8-inch cover on exterior face.
- C. Wire Veneer Anchors: Wire ties formed from W1.7 or 0.148-inch- diameter, hotdip galvanized stainless steel wire.
 - 1. Ties are bent in the form of loops with legs not less than 15 inches in length and with last 2 inches bent at 90 degrees.
 - 2. Ties are bent in the form of rectangular loops with ends bent downward for inserting into eyes projecting from masonry joint reinforcement specified in Section 042000 "Unit Masonry."
 - 3. Ties are bent in the form of triangular loops designed to be attached to masonry joint reinforcement specified in Section 042000 "Unit Masonry" with vertical wires passing through ties and through eyes projecting from masonry joint reinforcement.
- D. Corrugated-Metal Veneer Anchors: Not less than 0.030-inch- 0.060-inch- thick by 7/8-inch- wide hot-dip galvanized stainless steel sheet with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch.
- E. Adjustable Masonry-Veneer Anchors:
 - 1. General: Provide anchors that allow vertical adjustment but resist a 100lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
 - 2. Fabricate sheet metal anchor sections and other sheet metal parts from [0.075-inch- thick steel sheet, galvanized after fabrication] [0.105-inch-thick steel sheet, galvanized after fabrication] [0.078-inch- thick, stainless steel sheet] [0.109-inch- thick, stainless steel sheet].
 - 3. Fabricate wire ties from [0.187-inch-] [0.25-inch-] diameter, hot-dip galvanized-steel wire unless otherwise indicated.
 - 4. Fabricate wire connector sections from [0.187-inch-] [0.25-inch-] diameter, hot-dip galvanized-steel wire.
 - 5. Contractor's Option: Unless otherwise indicated, provide any of the adjustable masonry-veneer anchors specified.

2.5 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing, complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
 - 1. Stainless Steel: ASTM A240/A240M, Type 304, 0.016 inch thick.
 - 2. Copper: ASTM B370, Temper H00 or H01, cold-rolled copper sheet, 10oz./sq. ft. weight or 0.0135 inch thick for fully concealed flashing; 16oz./sq. ft. weight or 0.0216 inch thick elsewhere.
- B. Application: Unless otherwise indicated, use the following:
 - 1. Where flashing is fully concealed, use metal flashing.
- C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."
- D. Adhesives, Primers, and Seam Tapes for Flexible Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.6 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane PVC.
- B. Cementitious Dampproofing for Limestone: Cementitious formulation recommended by ILI and nonstaining to stone, compatible with joint sealants, and noncorrosive to veneer anchors and attachments.
- C. Asphalt Dampproofing: Cut-back asphalt complying with ASTM D4479/D4479M, Type I asphalt emulsion complying with ASTM D1227, Type III or Type IV.
- D. Weep/Vent Products: Use one of the following unless otherwise indicated:
 - 1. Wicking Material: Absorbent rope, made from cotton UV-resistant synthetic fiber, 1/4 to 3/8 inch in diameter, in length required to produce 2-inch exposure on exterior and 18 inches in cavity behind stone masonry. Use only for weeps.
 - 2. Round Plastic Tubing: Medium-density polyethylene, 3/8-inch OD by thickness of stone masonry.
 - 3. Rectangular Plastic Tubing: Clear butyrate, 3/8 by 1-1/2 inches by thickness of stone masonry.
 - 4. Mesh Weep Holes/Vents: Free-draining mesh; made from polyethylene strands, full width of head joint and 2 inches high by thickness of stone masonry; in color selected from manufacturer's standard.

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

2.7 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar and grout stains, efflorescence, and other new construction stains from stone masonry surfaces without discoloring or damaging masonry surfaces; expressly approved for intended use by cleaner manufacturer and stone producer.

2.8 FABRICATION

- A. General: Fabricate stone units in sizes and shapes required to comply with requirements indicated.
 - 1. For limestone, comply with recommendations in ILI's "Indiana Limestone Handbook."
- B. Cut stone to produce pieces of thickness, size, and shape indicated, including details on Drawings and pattern specified in "Setting Stone Masonry" Article.
 - 1. Shape stone specified to be laid in three-course, random range ashlar pattern with sawed beds.
- C. Thickness of Stone: Provide thickness indicated, but not less than the following:
 - 1. Thickness: 4 inches plus or minus 1/4 inch.

2.9 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.
 - 1. Do not use calcium chloride.
 - 2. Use portland cement-lime mortar unless otherwise indicated.
 - 3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
 - 4. Mixing Pointing Mortar: Thoroughly mix cementitious and aggregate materials together before adding water. Then mix again, adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for one to two hours. Add remaining water in small portions until mortar reaches required consistency. Use mortar within 30 minutes of final mixing; do not retemper or use partially hardened material.

- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Stone Masonry: Comply with ASTM C270, Proportion Property Specification.
 - 1. Mortar for Setting Stone: Type S Type N.
 - 2. Mortar for Pointing Stone: Type N Type O.
- D. Pigmented Mortar: Use colored cement product.
 - 1. Pigments do not exceed 10 percent of portland cement by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces indicated to receive stone masonry, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of stone masonry.
- B. Examine substrate to verify that dovetail slots, inserts, reinforcement, veneer anchors, flashing, and other items installed in substrates and required for or extending into stone masonry are correctly installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coat concrete and unit masonry backup with asphalt dampproofing.
- B. Clean dirty or stained stone surfaces by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.

3.3 INSTALLATION OF STONE MASONRY

- A. Perform necessary field cutting and trimming as stone is set.
 - 1. Use power saws to cut stone that is fabricated with saw-cut surfaces. Cut lines straight and true, with edges eased slightly to prevent snipping.

- 2. Use hammer and chisel to split stone that is fabricated with split surfaces. Make edges straight and true, matching similar surfaces that were shop or guarry fabricated.
- 3. Pitch face at field-split edges as needed to match stones that are not field split.
- B. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.
- C. Arrange stones in range ashlar pattern with course heights as indicated, [uniform] [random] lengths, and uniform joint widths, with offset between vertical joints as indicated.
- D. Arrange stones in broken-range ashlar pattern with uniform course heights, random lengths, and uniform joint widths.
- E. Arrange stones in three-course, random-range ashlar pattern with random course heights, random lengths (interrupted coursed), and uniform joint widths.
- F. Arrange stones in [coursed] [uncoursed] rubble pattern with joint widths within tolerances indicated.[Insert small stones into spaces between larger stones as needed to produce joints as uniform in width as practical.]
- G. Arrange stones with color and size variations uniformly dispersed for an evenly blended appearance.
- H. Install supports, fasteners, and other attachments indicated or necessary to secure stone masonry in place.
- I. Set stone accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
- J. Install steel lintels where indicated. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.
- K. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment if any. Lay walls with joints not less than [1/4 inch] [3/8 inch] at narrowest points or more than [3/8 inch] [1/2 inch] [5/8 inch] [1 inch] [1-1/2 inches] at widest points.
- L. Provide sealant joints of widths and at locations indicated.
 - 1. Keep sealant joints free of mortar and other rigid materials.
 - 2. Sealant joints are specified in Section 079200 "Joint Sealants."

- M. Install metal expansion strips in sealant joints at locations indicated. Build flanges of expansion strips into masonry by embedding in mortar between stone masonry and backup wythe. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
- N. Install embedded flashing[and weep holes] at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
 - 1. At stud-framed walls, extend flashing through stone masonry, up sheathing face at least [8 inches] [12 inches] [16 inches], and behind weather barrier.
 - 2. At multiwythe masonry walls, including cavity walls, extend flashing through stone masonry, turned up a minimum of [4 inches] [8 inches] [12 inches] [16 inches], and extend into or through inner wythe to comply with requirements in Section 042000 "Unit Masonry."
 - 3. At concrete backing, extend flashing through stone masonry, turned up a minimum of [4 inches] [6 inches] [8 inches] [12 inches], and insert in reglet.[Reglets are specified in Section 076200 "Sheet Metal Flashing and Trim."]
 - 4. At lintels and shelf angles, extend flashing full length of angles but not less than 6 inches into masonry at each end.
 - 5. At sills, extend flashing not less than 4 inches at ends.
 - 6. At ends of head and sill flashing, turn up not less than 2 inches to form end dams.
 - Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 - 8. Install metal drip edges sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 - 9. Extend sheet metal flashing 1/2 inch beyond masonry face at exterior, and turn flashing down to form a drip.
 - 10. Install metal drip edges beneath flexible flashing at exterior wall face. Stop flexible flashing 1/2 inch back from exterior wall face and adhere flexible flashing to top of metal drip edge.
 - 11. Install metal flashing termination beneath flexible flashing at exterior wall face. Stop flexible flashing 1/2 inch back from exterior wall face and adhere flexible flashing to top of metal flashing termination.
 - 12. Cut flexible flashing flush with wall face after completing masonry wall construction.
- O. Place weep holes and vents in joints where moisture may accumulate, including at base of cavity walls, above shelf angles, and at flashing.
 - 1. Use wicking material mesh weep holes/vents aluminum weep holes/vents vinyl weep holes/vents to form weep holes.

- 2. Use wicking material to form weep holes above flashing in stone sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
- 3. Space weep holes [16 inches] [24 inches] o.c.
- 4. Space weep holes formed from [plastic tubing] [or] [wicking material] 16 inches o.c.
- 5. Trim wicking material used in weep holes flush with exterior wall face after mortar has set.
- 6. Place pea gravel in cavities as soon as practical to a height of not less than 2 inches above top of flashing, to maintain drainage.
- 7. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- P. Install vents in head joints at top of each continuous cavity at spacing indicated. Use mesh weep holes/vents aluminum weep holes/vents vinyl weep holes/vents to form vents.
 - 1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.
- Q. Coat limestone with cementitious dampproofing as follows:
 - 1. Stone at Grade: Beds, joints, and back surfaces to at least 12 inches above finish-grade elevations.
 - 2. Stone Extending below Grade: Beds, joints, back surfaces, and face surfaces below grade.
 - 3. Allow cementitious dampproofing formulations to cure before setting dampproofed stone. Do not damage or remove dampproofing in the course of handling and setting stone.

3.4 CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, expansion joints, control joints, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
- B. Variation from Level: For[bed joints and] lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
- C. Variation of Linear Building Line: For position shown in plan, do not exceed 1/2 inch in 20 feet or 3/4 inch in 40 feet or more.
- D. Measure variation from level, plumb, and position shown in plan as a variation of the average plane of each stone face from level, plumb, or dimensioned plane.

- E. Variation in Mortar-Joint Thickness: Do not vary from joint size range indicated.
- F. Variation in Plane between Adjacent Stones: Do not exceed one-half of tolerance specified for thickness of stone.

3.5 INSTALLATION OF ANCHORED STONE MASONRY

- A. Anchor stone masonry to concrete with corrugated-metal veneer anchors unless otherwise indicated. Secure anchors by inserting dovetailed ends into dovetail slots in concrete.
- B. Anchor stone masonry to unit masonry with [corrugated-metal] [or] [individual wire] veneer anchors unless otherwise indicated. Embed anchors in unit masonry mortar joints or grouted cells at a distance of at least one-half of unit masonry thickness.
- C. Anchor stone masonry to unit masonry with wire anchors unless otherwise indicated. Connect anchors to masonry joint reinforcement by inserting pintles into eyes of masonry joint reinforcement projecting from unit masonry.
- D. Anchor stone masonry to unit masonry with wire anchors unless otherwise indicated. Connect anchors to masonry joint reinforcement with vertical rods inserted through anchors and through eyes of masonry joint reinforcement projecting from unit masonry.
- E. Anchor stone masonry to unit masonry with [adjustable, screw-attached] [seismic] veneer anchors unless otherwise indicated. Fasten anchors to unit masonry with two screws.
- F. Anchor stone masonry to stud framing with [adjustable, screw-attached] [seismic] veneer anchors unless otherwise indicated. Fasten anchors through sheathing to framing with two screws.
- G. Anchor stone masonry to stud framing with screw-attached veneer anchors unless otherwise indicated.
- H. Anchor stone masonry to wood-stud framing with corrugated-metal veneer anchors unless otherwise indicated. Fasten anchors through sheathing to studs with corrosion-resistant roofing nails.
- I. Anchor stone masonry to wood-stud framing with wire anchors unless otherwise indicated. Fasten anchors through sheathing to wood studs with corrosion-resistant roofing nails.
- J. Anchor stone masonry to metal-stud framing with wire anchors unless otherwise indicated. Tie anchors to studs.

- K. Embed veneer anchors in mortar joints of stone masonry at least halfway, but not less than 1-1/2 inches, through stone masonry and with at least a 5/8-inch cover on exterior face.
 - 1. Install continuous wire reinforcement in horizontal joints and attach to seismic veneer anchors as stone is set.
- L. Space anchors to provide not less than one anchor per 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings, sealant joints, and perimeter at intervals not exceeding 12 inches.
- M. Space anchors not more than 16 inches o.c. vertically and 24 inches o.c. horizontally. Install additional anchors within 12 inches of openings, sealant joints, and perimeter at intervals not exceeding 12 inches.
- N. Space anchors not more than 18 inches o.c. vertically and 32 inches o.c. horizontally, with not less than one anchor per 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings, sealant joints, and perimeter at intervals not exceeding 12 inches.
- O. Anchor stone trim with stone trim anchors where indicated. Install anchors by fastening to substrate and inserting tabs and dowels into kerfs and holes in stone units. Provide compressible filler in ends of dowel holes and bottoms of kerfs to prevent end bearing of dowels and anchor tabs on stone. Fill remainder of anchor holes and kerfs with mortar.
- P. Set stone in full bed of mortar with full head joints unless otherwise indicated. Build anchors into mortar joints as stone is set.
- Q. Fill [collar joint] [space between back of stone masonry and weather-resistant sheathing paper] with mortar as stone is set.
- R. Provide [1-inch] [2-inch] cavity between stone masonry and backup construction unless otherwise indicated. Keep cavity free of mortar droppings and debris.
 - 1. Slope beds toward cavity to minimize mortar protrusions into cavity.
 - 2. Do not attempt to trowel or remove mortar fins protruding into cavity.
- S. Rake out joints for pointing with mortar to depth of not less than [1/2 inch] [3/4 inch] before setting mortar has hardened. Rake joints to uniform depths with square bottoms and clean sides.

3.6 POINTING

A. Prepare stone-joint surfaces for pointing with mortar by removing dust and mortar particles. Where setting mortar was removed to depths greater than surrounding areas, apply pointing mortar in layers not more than 3/8 inch deep until a uniform depth is formed.

- B. Point stone joints by placing and compacting pointing mortar in layers of not more than 3/8 inch deep. Compact each layer thoroughly and allow to it become thumbprint hard before applying next layer.
- C. Tool joints, when pointing mortar is thumbprint hard, with a smooth jointing tool to produce the following joint profile:
 - 1. Joint Profile: Concave
- 3.7 ADJUSTING AND CLEANING
 - A. Remove and replace stone masonry of the following description:
 - 1. Broken, chipped, stained, or otherwise damaged stone. Stone may be repaired if methods and results are approved by Architect.
 - 2. Defective joints.
 - 3. Stone masonry not matching approved samples and mockups.
 - 4. Stone masonry not complying with other requirements indicated.
 - B. Replace in a manner that results in stone masonry matching approved samples and mockups, complying with other requirements, and showing no evidence of replacement.
 - C. In-Progress Cleaning: Clean stone masonry as work progresses. Remove mortar fins and smears before tooling joints.
 - D. Final Cleaning: After mortar is thoroughly set and cured, clean stone masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on mockup; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before cleaning stone masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaner; remove cleaner promptly by rinsing thoroughly with clear water.
 - 5. Clean stone masonry by bucket and brush hand-cleaning method described in BIA Technical Note No. 20, Revised II, using job-mixed detergent solution.
 - 6. Clean stone masonry with proprietary acidic cleaner applied according to manufacturer's written instructions.
 - 7. Clean limestone masonry to comply with recommendations in ILI's "Indiana Limestone Handbook."

3.8 EXCESS MATERIALS AND WASTE

- A. Excess Stone: Stack excess stone where directed by Owner for Owner's use.
- B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed.
 - 1. Crush masonry waste to less than 4 inches in greatest dimension.
 - Mix masonry waste with at least 2 parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
 - 3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other waste, and legally dispose of off Owner's property.

END OF SECTION

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal decorative railings.

1.3 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver items to Project site in time for installation.

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's product lines of decorative metal railings assembled from standard components.
 - 2. Perforated metal infill panels.
 - 3. Fasteners.
 - 4. Post-installed anchors.
 - 5. Handrail brackets.
 - 6. Shop primer.
 - 7. Bituminous paint.
 - 8. Nonshrink, nonmetallic grout.
 - 9. Anchoring cement.
 - 10. Metal finishes.
- B. Shop Drawings: Include plans, elevations, sections, and attachment details.

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- C. Samples for Initial Selection: For products involving selection of color, texture, or design.
- D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.5 INFORMATIONAL SUBMITTALS
 - A. Qualification Data: For testing agency.
 - B. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.
 - C. Welding certificates.
 - D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
 - E. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.
- 1.7 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 PERFORMANCE REQUIREMENTS
 - A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment indicated on plans.
 - B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:

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- a. Uniform load of 50 lbf/ft. applied in any direction.
- b. Concentrated load of 200 lbf applied in any direction.
- c. Uniform and concentrated loads need not be assumed to act concurrently.
- 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior railings by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- 2.2 METALS, GENERAL
 - A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
 - B. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.
- 2.3 FASTENERS
 - A. Fastener Materials:
 - 1. Aluminum Railing Components: Type 304 Type 316 stainless steel fasteners.
 - 2. Stainless Steel Railing Components: Type 304 Type 316 stainless steel fasteners.
 - 3. Ungalvanized-Steel Railing Components: Plated-steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for electrodeposited zinc coating where concealed; Type 304 stainless steel fasteners where exposed.
 - 4. Hot-Dip Galvanized-Steel 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.
 - 5. Dissimilar Metal Railing Components: Type 304 Type 316 stainless steel fasteners.
 - 6. Finish exposed fasteners to match appearance, including color and texture, of railings.

- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated exposed fasteners are unavoidable exposed fasteners are the standard fastening method for railings indicated.
 - 1. Provide Phillips tamper-resistant square or hex socket flat-head machine screws for exposed fasteners unless otherwise indicated.
- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, in accordance with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 Group 2 stainless steel bolts, ASTM F593 and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: Cast-aluminum and Cast stainless steel 2-1/2 inches 3-1/8 inches Insert dimension from face of railing wall.
 - 1. Provide cast-metal brackets with flange tapped for concealed anchorage to threaded hanger bolt.
 - 2. Provide either formed- or cast-metal brackets with predrilled hole for exposed bolt anchorage.
 - 3. Provide extruded-aluminum brackets with interlocking pieces that conceal anchorage. Locate set screws on bottom of bracket.
 - 4. Provide formed-steel brackets with predrilled hole for bolted anchorage and with snap-on cover that matches rail finish and conceals bracket base and bolt head.
- B. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

- E. Shop Primer for Galvanized Steel: Cementitious galvanized metal primer complying with MPI#26 Vinyl wash primer complying with MPI#80 Water-based galvanized metal primer complying with MPI#134.
- F. Epoxy Intermediate Coat: Complying with MPI#77 and compatible with primer and topcoat.
- G. Polyurethane Topcoat: Complying with MPI#72 and compatible with undercoat.
- H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- I. 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.
- J. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydrauliccontrolled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations and where indicated on Drawings, 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.

2.5 FABRICATION

- A. 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 will be exposed to weather in a manner to exclude 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 or mechanical 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 Finish #1 welds; ornamental quality with no evidence of a welded joint.
- I. 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. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings.
 - 1. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 2. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.
- K. Form changes in direction as follows:
 - 1. By bending to smallest radius that will not result in distortion of railing member.
- 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. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns, unless clearance between end of rail and wall is 1/4 inch or less.
- O. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, handrail brackets, miscellaneous fittings, and anchors to interconnect railing members to other Work unless otherwise indicated.
 - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and to prevent bracket or fitting rotation and crushing of substrate.
- P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry Work.
 - 1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 - 2. Coordinate anchorage devices with supporting structure.
- Q. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- R. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from same metal as railings in which they are installed.
 - 1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than 0.043 inch thick.
 - 2. Orient perforated metal with pattern per plans.

2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

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2.7 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: As indicated by manufacturer's designations Match Architect's sample As selected by Architect from manufacturer's full range Insert color and gloss.

2.8 STEEL FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
 - 2. Hot-dip galvanize indicated steel railings, including hardware, after fabrication.
 - 3. Comply with ASTM A123/A123M for hot-dip galvanized railings.
 - 4. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
 - 5. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 - 6. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows:
 - 1. Comply with SSPC-SP 16.
- D. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 - 1. Do not apply primer to galvanized surfaces.
- E. Powder-Coat Finish for Galvanized Metal: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:
 - 1. Prepare galvanized metal by thoroughly removing grease, dirt, oil, flux, and other foreign matter.

- 2. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
- 3. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness of not less than 1.5 mils.
- 4. Color: As indicated by manufacturer's designations Match Architect's sample As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. 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 have been 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.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- 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 inplace construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

- A. Use stainless steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Form or core-drill holes not less than 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, mixed and placed to comply with anchoring material manufacturer's written instructions.
- C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- D. Leave anchorage joint exposed with 1/8-inch buildup, sloped away from post.
- E. Anchor posts to metal surfaces with flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For aluminum railings, attach posts as indicated, using fittings designed and engineered for this purpose.
 - 2. For stainless steel railings, weld flanges to posts and bolt to metalsupporting surfaces.

- 3. For steel railings, weld flanges to posts and bolt to metal-supporting surfaces.
- F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends to concrete and masonry with flanges connected to brackets on underside of rails connected to railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends connected to railing ends, using nonwelded connections.
- C. Attach handrails to walls with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.
 - 1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

3.6 REPAIR

- A. Touchup Painting:
 - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
 - 2. Touchup Painting: Clean and touchup painting of field welds, bolted connections, and abraded areas of shop paint per manufacturer's recommendations and specifications.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and to prepare test reports. Payment for these services will be made by Owner.

- B. Extent and Testing Methodology: Testing agency will randomly select completed railing assemblies for testing that are representative of different railing designs and conditions in the completed Work. Test railings in accordance with ASTM E894 and ASTM E935 for compliance with performance requirements.
- C. Remove and replace railings where test results indicate that they do not comply with specified requirements unless they can be repaired in a manner satisfactory to Architect and comply with specified requirements.
- D. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
- 3.8 CLEANING
 - A. Clean by washing thoroughly with clean water and soap, rinsing with clean water, and wiping dry.
- 3.9 PROTECTION
 - A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
 - B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION

DOCUMENT 221100 - WATER DISTRIBUTION PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes domestic cold water, hot water, and hot water recirculation piping, fittings, and specialties within the building to a point 5 feet outside the building.
- B. Contractors Option:
 - 1. The Division 22 contractor may provide mechanically joined plumbing piping systems to connect mechanical joints, couplings, fittings, valves, and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods. Mechanically joined water distribution piping systems where used shall be provided in compliance with specification Section 221111 "Mechanically Joined Plumbing Piping Systems".
- C. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
 - 2. Division 2 Section "Water Service Systems," for water service piping beginning from 5'-0" outside the building.
 - 3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
 - 4. Division 11 Section "Kitchen and Food Service Equipment," for faucets and valves furnished with the food service and kitchen equipment.
 - 5. Division 22 Section "Identification, for Plumbing Piping and Equipment" for labeling and identification of water distribution piping.
 - 6. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall penetrations and equipment pads.
 - 7. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, flexible connectors, unions, dielectric unions, dielectric flanges, and mechanical sleeve seals.
 - 8. Division 22 Section "General Duty Valves for Plumbing Piping," for materials and methods for installing water distribution piping valves.
 - 9. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields, materials, and methods for hanging and supporting water distribution piping.
 - 10. Division 22 Section "Plumbing Insulation," for materials and methods for insulating water distribution piping.

11. Division 22 Section "Sanitary Drainage and Vent Piping and Specialties," for material and methods for trap primer outlet piping.

1.2 DEFINITIONS

- A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.
- B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distribution pipe of the building served.
- C. Pipe sizes used in this Specification are nominal pipe size (NPS).
- D. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
 - 1. Product data for each piping specialty and valve specified.
 - 2. Welder Certificates signed by Contractor certifying that welders comply with requirements specified in Article "Quality Assurance" below.
 - 3. Certification of Compliance with ASME and UL fabrication requirements specified in Article "Quality Assurance" below.
 - 4. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
 - 5. Test reports specified in Part 3 of this Section.
 - 6. Submit certification that specialties and fittings for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following specialties need not comply:
 - a. Hose bibbs
 - b. Wall, yard, and roof hydrants
 - c. Backflow preventers isolating irrigation or mechanical make-up systems
 - d. Trap primers

1.4 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."

- B. Regulatory Requirements: Comply with the provisions of the following codes:
 - 1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 - 2. ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications" for Qualifications for Welding Processes and Operators.
- C. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.
- D. Pipe, fittings, and specialties shall be manufactured in the United States or be certified to meet ASTM and ANSI standards.

1.5 SPARE PARTS

A. Maintenance Stock: Furnish one valve key for each key-operated wall hydrant, hose bibb, fixture supply, or faucet installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hose Bibbs:
 - a. Lee Brass Co.
 - b. Mansfield Plumbing Products
 - c. Mifab Manufacturing, Inc.
 - d. Nibco, Inc.
 - e. Prier, Inc.
 - f. Watts Regulator Co.
 - g. Woodford Mfg. Co.
 - 2. Wall/Yard Hydrants:
 - a. Josam Co.
 - b. Mifab Manufacturing, Inc.
 - c. Smith (Jay R.) Mfg. Co.

- d. Prier, Inc.
- e. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
- f. Watts Drainage
- g. Woodford Mfg. Co.
- h. Zurn Industries Inc., Hydromechanics Div.
- 3. Backflow Preventers:
 - a. Cla-Val Co.
 - b. Conbraco Industries, Inc.
 - c. Febco
 - d. Hersey Products, Inc.
 - e. Mifab Manufacturing, Inc./Beeco
 - f. Watts Regulator Co.
 - g. Zurn Industries Inc. Wilkins Regulator Div.
- 4. Self Contained Pressure-Reducing Valves:
 - a. Cash (A. W.) Valve Mfg. Corp.
 - b. Cla-Val Co.
 - c. Conbraco Industries, Inc.
 - d. Mifab Manufacturing, Inc./Beeco
 - e. Watts Regulator Co.
 - f. Zurn Industries Inc., Wilkins Regulator Div.
- 5. Relief Valves:
 - a. Cash (A. W.) Valve Mfg. Corp.
 - b. Conbraco Industries, Inc.
 - c. Watts Regulator Co.
 - d. Zurn Industries, Inc. Wilkins Regulator Div.
- 6. Piston Type Water Hammer Arresters:

- a. Amtrol, Inc.
- b. Josam Co.
- c. Precision Plumbing Products, Inc.
- d. PROFLO
- e. Sioux Chief Manufacturing Co.
- f. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
- g. Watts Regulator Co.
- h. Zurn Industries, Inc. Wilkins Regulator Div.
- 7. Point of Use Thermostatic Mixing Valves
 - a. Acorn Engineering Co.
 - b. Cash Acme
 - c. Leonard Valve Co.
 - d. Powers Process Controls
- 8. Plumbing Pipe Support Brackets
 - a. Holdrite
 - b. PROFLO
 - c. Sioux Chief
- 9. Tube Suspension Clamps
 - a. PROFLO
 - b. Sioux Chief or approved Equivalent
- 10. Sanitary Roof Hydrants
 - a. Hoeptner Perfected Products
 - b. Jay R. Smith Mtg Co.
 - c. Prier, Inc.
 - d. Mapa
 - e. Woodford Mfg. Co.

2.2 PIPE AND TUBE MATERIALS, GENERAL

- A. Pipe and Tube: Refer to Part 3, Articles "Above Ground Water Distribution Pipe and Fittings" or "Below Ground Water Distribution Pipe and Fittings", for identification of systems where the materials listed below are used.
- B. Copper Tube: ASTM B88, Type L Water Tube, drawn temper.
- C. Copper Tube: ASTM B88, Type K Water Tube, annealed temper.
- D. Ductile-Iron Pipe: AWWA C151 or AWWA C115 ductile-iron pipe, with AWWA C104 cementmortar lining.
- E. Brass Pipe: Chrome Plated Schedule 40 ASTM B43 iron pipe size (IPS.)

2.3 FITTINGS

- A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern.
- B. Ductile or Gray-Iron Flanged Fittings: AWWA C110 Class 125 with AWWA C116 epoxy coating inside and outside.
- C. Ductile-Iron Gasketed Fittings: AWWA C153, 150 psi rating, with AWWA C104 cement mortar lining and AWWA C111 rubber gaskets.
- D. Brass Fittings: Chrome plated ANSI B16, Class 125 with threaded connections.
- E. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125, raised ground face, bolt holes spot faced.
- F. Bronze Flanges: ANSI B16.24, Class 150, raised ground face, bolt holes spot faced.
- G. PVC to Ductile Iron Adapter Flanges: EBBA Iron, Inc. Series 2000PV or approved equivalent.

2.4 JOINING MATERIALS

- A. Solder Filler Metal: ASTM B32 Alloy Sb-5, 95-5 Tin-Antimony.
- B. Brazing Filler Metals: AWS A5.8, Bag-7 Silver.
- C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressures.
- 2.5 GENERAL-DUTY VALVES
 - A. General-duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 22 Section "General Duty Valves for Plumbing Piping." Special duty valves are specified below by their generic name; refer to Part 3, Article "Valve Applications" for specific uses and applications for each valve specified.
- 2.6 PIPING SPECIALTIES
 - A. Hose Connections: Hose connections shall have garden hose thread outlets conforming to ASME B1.20.7.
- B. Hose Bibbs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.
- C. Recessed Nonfreeze Wall Hydrants: Cast-bronze box, with chrome-plated face, tee handle key, vacuum breaker, hinged locking cover, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit wall thickness.
- D. Nonfreeze Yard Hydrants: Cast-bronze hydrant, drain hole, vacuum breaker, hinged locking handle, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit depth of bury.
- E. Roof Hydrants: As specified on the drawings.
- F. Backflow Preventers: Comply with requirements of ASSE Standard 1013 and as specified on the drawings.
- G. Pressure Reducing Valves: Comply with requirements of ASSE Standard 1003 and as specified on the drawings.
- H. Relief Valves: Sizes for relief valves shall be in accordance with ASME Boiler and Pressure Vessel Codes for indicated capacity of the appliance for which installed.
 - 1. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Temperature relief valves shall be factory set at 210 deg F, and pressure relief at 150 psi.
- I. Piston Type Water Hammer Arresters: Piston type, with casing of type "L" copper tube and spun copper ends, nylon piston with two EPDM "O"rings pressure lubricated with FDA approved silicone, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.
- J. Point of Use Thermostatic Mixing Valves:
 - 1. Lead free bronze or brass body meeting ASTM B584 with non-corrosive parts, tamper resistant temperature adjustment, checks, stops, other components as scheduled and meeting ASSE 1070. Valve shall be designed to fail to the cold side of the system. Maximum pressure drop shall not be exceeded for the scheduled flow rate.
- K. Pipe Support Brackets:
 - 1. Sheet Stud Bracket: 20 gauge copper with nominal copper tube holes of 1/2" on 2" centers and holes of 3/4" or 1" on 4" centers.
 - 2. Pipe Mounted Bracket: 20 gauge copper or plastic bracket with clamps for securing copper water tube and stainless steel hose clamp for securing bracket to vertical waste and vent pipe in wall.
 - 3. Carrier Bracket: 20 gauge copper bracket with 1" hole for supporting rough-in for flush valve copper tube and bolt slot for attaching to chair carrier.
- L. Tube Suspension Clamps

1. Combination plastic supports and insulators for installing copper tube in stud walls with integral bracket for securing to stud with screws.

PART 3 - EXECUTION

1.1 INSTALLATION, GENERAL

A. Install piping, valves and specialties in accordance with manufacturer's installation instructions.

3.2 PREPARATION FOUNDATION FOR BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. Copper Tube: Provide 6" thick sand pipe bed underneath and around sides of pipe, up to middle half of the pipe. Support pipe in trench with sand bags level and true at fittings to prevent sand, gravel or debris from interfering with the brazing process. After pressure testing is complete, install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.
- B. Ductile Iron Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe up to middle half of the pipe, including fittings. After pressure testing is complete, provide first layer of pea gravel backfill 6" above pipe, tamp backfill with mechanical tamper and install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.
- 3.3 ABOVE GROUND WATER DISTRIBUTION PIPE AND FITTINGS
 - A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes
 - B. Install chrome plated brass pipe and fittings for exposed water piping within the building where indicated on the drawings.
 - C. Install ductile or gray-iron epoxy coated fittings for 3" and larger at water service entrance riser and only upstream of the backflow preventer.
- 3.4 BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS
 - A. Install Type K, soft annealed copper tube and brazed joints for pipe sizes 2 inches and smaller, with minimum number of joints, inside and outside building.
 - B. Install cement-lined ductile-iron pipe with rubber gasketed joints, inside and outside under the building, for pipe 3 inches and larger.
- 3.5 PIPING INSTALLATION
 - A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

- B. Use fittings for all changes in direction and branch connections.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.
- I. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- J. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves packing, and sealant. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.
- K. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.
- L. Install piping level with no pitch.
- 3.6 HANGERS AND SUPPORTS
 - A. General: Hanger, support, insulation protection shield and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
 - B. Pipe Attachments: Install the following:
 - 1. Adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
 - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs. Provide copper coated riser clamps when in contact with copper tube.

- 3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Supports and Anchors" and "Plumbing Insulation".
- 4. Copper coated extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of copper tube 2" and smaller on walls and for securing 1-1/4" to 2" copper tube inside walls and chases for battery fixtures. Secure clamp to the copper tube.
 - a. Seal each joint with insulation and split ring pipe to maintain the insulation barrier. Refer to Section "Plumbing Insulation" for requirement for maintenance of the vapor barrier and vapor barrier seal method.
- 5. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of stainless steel tube 2" and smaller on walls or for securing tube inside walls for connection to faucets.
- 6. Support copper tube in chases and walls at plumbing fixtures with plastic or copper brackets secured to structure and U-bolts sized to bare on the pipe.
- 7. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube. Provide two piece straps and 360° insulation protection shields sized for the insulation thickness used for the pipe for all insulated pipes.
- 8. Secure copper tube rough-in for individual fixtures with sheet stud brackets attached to the wall studs or pipe mounting brackets attached to the fixture waste & vent pipe at each plumbing fixture.
- 9. Secure 1" and smaller copper water tubing in stud walls at stud penetrations with tube suspension clamps.
 - a. Cut hole through non-supporting studs with a minimum 1/8" clearance around each uninsulated copper tube or insulated copper tube.
 - b. Seal each joint of insulation and tube suspension clamp to maintain the insulation barrier. Refer to Division 22 "Plumbing Insulation" for requirement for maintenance of the vapor barrier similar to insulation butted against insulation inserts and vapor barrier seal method.
- 10. Secure copper tubes for flush valve wall mounted water closets to the chair carrier with carrier brackets.
- 11. Provide roll hangers for individual horizontal runs 100 feet or longer.
- C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe	Steel Pipe	Copper Tube	Min. Rod
<u>Size - In.</u>	<u>Max. Span - Ft.</u>	<u>Max. Span - Ft.</u>	<u>Dia In.</u>
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2
10 to 12	12	10	5/8
14	12	N/A	3/4
16	12	N/A	7/8

- 1. Support vertical steel pipe at each floor and in intervals not to exceed 15 feet.
- 2. Support vertical copper tube at each floor and in intervals not to exceed 10 feet.
- D. Support water piping within 12" of each elbow or tee and for water piping 2-1/2" and larger at each valve or strainer.
- E. Support water piping above the floor with pipe supports attached to the floor with anchor bolts where indicated on the drawings. Conform to the table above for maximum spacing of supports.

3.7 PIPE AND TUBE JOINT CONSTRUCTION

- A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
 - 1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.
 - 2. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
 - 3. Heat joints to proper and uniform temperature.
- C. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threads for field-cut threads. Join pipe fittings and valves as follows:
 - 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 - 2. Align threads at point of assembly.
 - 3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
 - 4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

- a. Damaged Threads: Do not use pipe with corroded or damaged threads. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- D. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- E. Joints Containing Dissimilar Metals: Provide dielectric unions for 2" and smaller and dielectric flanges for piping 2-1/2" and larger. Provide dielectric waterway fittings for 2" and smaller in concealed locations. Dielectric unions, waterway fittings and flanges are specified in Section "Basic Piping Materials and Methods".
- F. Joints at Valve Assemblies or Connections to Equipment: Provide unions downstream of shutoff valves at valve assemblies or equipment connections. Unions are not required at flanged connections. Unions are specified in Division 22 section "Basic Piping Materials and Methods".

3.8 SERVICE ENTRANCE

- A. Extend water distribution piping to connect to water service piping, of size and in location indicated for service entrance to building. Water service piping is specified in a separate section of Division 2.
- B. Underground exterior water distribution piping to be a depth as required by local conditions, in accordance with authority having jurisdiction's requirements and at depth no less than 18" below grade.
- C. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.
- D. Install sleeve and caulk at penetrations through building floor for watertight installation.
- E. Install shutoff valve at service entrance inside building; complete with strainer, pressure gauge, and test tee with valve.
- F. Ductile-Iron Pipe: Install in accordance with AWWA C-600. Pipe below ground inside building and to a point 5 feet outside of building shall have restrained joints.

3.9 VALVE APPLICATIONS

- A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shut-off duty: Use gate, ball, and butterfly valves.
 - 2. Throttling duty: Use globe, ball, and butterfly valves.
- 3.10 INSTALLATION OF VALVES
 - A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use ball valves; for sectional valves 2-1/2 inches and larger, use ball or butterfly valves.

- B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on each supply to each plumbing fixture, and elsewhere as indicated. For shutoff valves 2 inches and smaller, use ball valves; for shutoff valves 2-1/2 inches and larger, use ball or butterfly valves.
- C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves 2 inches and smaller, use ball valves; for drain valves 2-1/2 inches and larger, use ball or butterfly valves.
- D. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.
- E. Hose Bibbs: Install on exposed piping where indicated with vacuum breaker.
- F. Wall Hydrants: Install where indicated with vacuum breaker.
- G. Point-of-Use Thermostatic Mixing Valve: Install valve complying with ASSE 1070 on all public lavatories and handwashing sink locations. Install valve to be accessible by maintenance staff. Set temperature limit to 110F for dual temperature faucet or 100F for single temperature faucet."
- 3.11 INSTALLATION OF FLOW CONTROL VALVES
 - A. Install flow control valves or automatic flow control valves in each hot water recirculating loop, and elsewhere as indicated. Install a shutoff valve and strainer upstream and a union, check valve and shutoff valve downstream of each flow control or automatic flow control valve.
 - B. Set flow control valve flow rate as follows:
 - 1. Preliminary Procedures For Hot Water Return System Balancing:
 - a. Before operating the system perform these steps:
 - 1) Open valves at recirculation pump and flow control valves to full open position.
 - 2) Remove and clean all strainers.
 - 3) Check recirculation pump rotation.
 - 4) Set water heater temperature as indicated on the drawings.
 - 2. Procedures For Hot Water Return System Balancing
 - a. Refer to the drawings for required flow rate for each flow control valve.
 - b. Provide required instrumentation to obtain proper measurements. Instruments shall be properly maintained and protected against damage.

- c. Apply instrument as recommended by the manufacturer.
- d. Take readings with the eye at the level of the indicated value to prevent parallax.
- e. Mark flow control valve setting with memory stop. Mark with paint or other suitable, permanent identification materials.
- f. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.
- C. Reports: Prepare hot water return system balancing reports signed and submit to the Architect upon completion of the project. Include the following information:
 - a. Valve tag number and description of location
 - b. Valve body size
 - c. Differential pressure reading from instrument in psi
 - d. Actual flow rate derived from the manufacturer's charts and tables for the valve size and measured differential pressure.

3.12 INSTALLATION OF PIPING SPECIALTIES

- A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as equipment being connected. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain.
- B. Install pressure reducing valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gauge on valve outlet.

3.13 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.
- B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection. For connections 2-1/2 inches and larger, use flanges instead of unions.

3.14 FIELD QUALITY CONTROL

- A. Inspections: Inspect water distribution piping as follows:
 - 1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
 - 2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

- a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed in after system is roughed in and prior to setting fixtures.
- b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
- c. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
- d. Reports: Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.
- B. Piping System Test: Test water distribution systems in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
 - 1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
 - 2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
 - 3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
 - 5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.15 ADJUSTING AND CLEANING

- A. Clean and disinfect water distribution piping as follows:
 - 1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
 - 2. Use the purging and disinfecting procedure proscribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:
 - a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.

- b. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
- c. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
- d. Following the allowed standing time, flush the system with clean, potable water until chlorine residual is lowered to incoming city water level.
- e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
- 3. Reports: Prepare disinfection reports signed by the authority having jurisdiction and turn over to the Architect upon completion of the project.

3.16 COMMISSIONING

- A. Fill the system. Check compression tanks to determine that they are not air bound and that the system is completely full of water.
- B. Before operating the system, perform these steps:
 - 1. Close drain valve, hydrants, and hose bibbs.
 - 2. Open valves to full open position.
 - 3. Remove and clean strainers.
 - 4. Check pumps for proper direction of rotation. Correct improper wiring.
 - 5. Lubricate pump motors and bearings.

END OF DOCUMENT 221100

DOCUMENT 271100 - TELECOMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes fittings that are within the physical walls of the communications equipment rooms to support the Telecommunications System. Fittings include but are not limited to:
 - 1. Bonding and Grounding (Earthing)
 - 2. Plywood Backboard
 - 3. Entrance Protection
 - 4. Cabinets, Racks, Frames, and Enclosures
 - 5. Termination Blocks and Patch Panels
 - 6. Patch Cables and Station Cords
 - 7. Cable Management and Ladder Rack
 - 8. Rack-mounted Power Equipment
- B. Section does not specify fittings such as cables, cable terminations, or faceplates for structured cable system (SCS). These components are specified in the Division 27 Section "Communications Backbone Cabling" and Division 27 Section "Communications Horizontal Cabling".
- C. Section does not specify fittings for audio video system(s). These components are specified in the Division 27 Section "Audio Video Systems" and "Broadcast Audio Video Systems".
- 1.2 RELATED SECTIONS INCLUDE THE FOLLOWING
 - A. Follow all applicable codes, references, and standards listed in Division 27 Sections "General Communications Requirements" and "Structured Cabling System".
 - B. Division 26 Section "Grounding and Bonding for Electrical Systems".

1.3 DEFINITIONS

- A. Backbone Bonding Conductor (BBC) The conductor that interconnects elements of the telecommunications grounding infrastructure.
- B. Communications Equipment Room This term shall apply to spaces specifically designed to maintain communications equipment. This definition shall encompass ANSI/TIA-569 terms for Entrance Room, Common Equipment Room (CER), and Common Telecommunications Room (CTR). This definition also shall encompass BICSI Telecommunications Distribution Methods Manual terms for Telecommunications Room (TR), Telecommunications Enclosure (TE), Equipment Room (ER), and Entrance Facility (EF).

- C. Communications Entrance Protection Fittings that reduce risk to life, limb, or property by protecting against power surges. This definition shall encompass protection devices and fittings described in Article 770 "Optical Fiber Cables and Raceways" and Article 800 "Communications Circuits" of NFPA 70 "National Electrical Code".
- D. Communications Cabinet A floor or wall mount unit enclosed with side panels. Communications equipment is supported by mounting rails separated at 19" or 23" inches.
- E. Communications Rack A floor or wall mount unit without side panels. Racks can be 2-post or 4-post. Communications equipment is supported by mounting rails separated at 19" or 23" inches.
- F. Communications Frame A floor or wall mount unit without side panels. Communications termination blocks are the only communications devices mounted to the unit.
- G. Communications Enclosure A floor or wall mount unit enclosed with side panels. Communications equipment is not supported by mounting rails separated by 19" or 23" inches. This definition shall encompass BICSI Telecommunications Distribution Methods Manual term for Telecommunications Enclosure (TE).
- H. Ground or Grounding A conducting connection, whether intentional or accidental, between an electrical circuit (e.g. telecommunications) or equipment and the earth, or to some conducting body that serves in place of earth.
- I. Primary Bonding Busbar (PBB) A busbar placed in a convenient and accessible location and bonded by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.
- J. Secondary Bonding Busbar (SBB) A busbar placed in a convenient and accessible location and bonded by means of the bonding conductor for telecommunications, to the building service equipment (power) ground.
- K. Telecommunications Bonding Backbone (TBB) A conductor that interconnects the Primary Bonding Busbar (PBB) to the Secondary Bonding Busbar (SBB).
- L. Telecommunications Bonding Conductor (TBC) A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground.

1.4 SUBMITTALS

- A. Follow the requirements for submittals in Division 27 Section "General Communications Requirements", as well as the detailed Submittal requirements in Section "Structured Cabling System". The following additional items shall be submitted:
- B. Pre-Bid Phase:
 - 1. For all products for which a substitute is to be considered as an approved equivalent or acceptable substitution provide submittals with sufficient detail for review by the Engineer. Submittals shall at a minimum provide detailed information substantiating all performance requirements as well as all necessary code compliance and NRTL listing information.
- C. "Pre-construction" submittal:

- 1. Shop Drawings:
 - a. Submit for review scaled layout drawings showing the layout of equipment racks, ground bars, wall mounted equipment and termination blocks, conduits, and ladder rack within telecom rooms. Ideally, this information would be indicated on scaled overall plans for each floor; however, it is permissible to combine with other Structured Cabling System shop drawings for individual areas.
- 2. Provide a typed list indicating part name, manufacturer, part number, and color (if applicable) for products specifically identified herein by the exact and complete part number (no wild-card characters).
- 3. Submit manufacturers' cut sheets or catalog cut sheets for each product specified.
- D. "Project Completion" submittal:
 - 1. As-built Drawings:
 - a. Submit scaled layout drawings showing the layout of all equipment and pathways in telecom rooms with final identifiers if applicable. Ideally, this information would be indicated on scaled overall plans for each floor; however, it is permissible to combine with other Structured Cabling System Record Drawings for individual areas.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of device from a single manufacturer and through one source. Where practical and possible, obtain all devices from a single manufacturer and one source.
- B. Communications equipment room fittings shall be listed by a NRTL.

1.6 WARRANTIES

A. Provide manufacturer warranties as required in Division 27 Section "Structured Cabling System".

PART 2 - PARTS

2.1 BONDING AND GROUNDING (EARTHING)

- A. General
 - 1. Provide a complete functioning telecommunications grounding and bonding system, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary for the system to be in compliance with the ANSI/TIA-607 Standard "Generic Telecommunications Bonding and Grounding for Customer Premises". Major components include:
 - a. PBB in the Entrance Facility and SBBs in all remaining Telecommunication Rooms and Spaces.

- b. TBC connecting the PBB to the main Electrical Service Ground.
- c. TBB connecting the PBB to all SBBs.
- d. All equipment and pathway grounding and bonding connections as identified on the drawings, recommended by manufacturers of equipment installed under this section, and stipulated in the referenced standard.
- 2. Available Component Manufacturers:
 - a. Chatsworth
 - b. Cooper B-Line
 - c. Erico
 - d. Harger
 - e. Hoffman
 - f. Panduit
- 3. Conductor Manufacturers
 - a. Shall be from the list of Component Manufacturers; or
 - b. Shall be from the list of Manufacturers in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
- B. Primary Bonding Busbar (PBB)
 - 1. Specifications
 - a. All busbars shall have a clear cover installed to protect connections
 - b. Cover shall be:
 - 1) Plexiglass or plastic
 - 2) Cover shall be printed with 3/8" lettering "PBB" using appropriate labels.
 - 3) Of the same manufacturer as the ground bar
 - c. A predrilled Electrotin plated copper busbar provided with holes for use with standard sized lugs; hole patterns shall be in TIA/BICSI style.
 - d. Have minimum dimensions of 1/4 inch thick x 4 inches wide x 20 inches long.
 - e. Provide enough length for all connections with 25% growth.
 - f. Provided with insulators to electrically isolate busbar from mounting surface.

- g. Provided with a minimum of 2-inches clearance from wall or other mounting surfaces for access.
- 2. Manufacturer shall be
 - a. Harger TGBIP14420TMGB
 - b. Chatsworth 40153-020
 - c. Or equivalent from Component Manufacturer
- C. Secondary Bonding Busbar (SBB)
 - 1. Specifications
 - a. Be a predrilled Electrotin plated copper busbar provided with holes for use with standard sized lugs
 - b. Have minimum dimensions of 1/4 inch thick x 2 inches wide x 12 inches long
 - c. Provided with insulators to electrically isolate busbar from mounting surface
 - d. Provided with a minimum of 2-inches clearance from wall or other mounting surfaces for access.
 - 2. Manufacturer shall be
 - a. Harger TGBI14212TGB
 - b. Chatsworth # 13622-012
 - c. Or equivalent from Component Manufacturer
- D. Ground Wire for TBB
 - 1. Specifications
 - a. All grounding and bonding connectors shall be listed by a Nationally Recognized Testing Laboratory (NRTL) as required by the NEC.
 - b. All grounding and bonding conductors shall be copper and may be insulated UON. When conductors are insulated, they shall be listed for the application (i.e. Plenum, riser, outside plant, etc.)
 - c. Ground Wire for TBB: Non-Insulated grounding wire with a minimum conductor size as indicated on drawings. Wire shall be UL listed.
 - d. Cable jacket marking: Shall be legible and shall contain the following information:
 - 1) Manufacturer's name.

- 2) Copper Conductor Gauge.
- 3) UL listing.
- e. Cable jacket shall be green with black lettering.
- f. Sizing shall be per Part 3 of this section. All sections of TBB longer than 300 feet shall be 750 kcmil.
- E. Bonding Conductor (To main Electrical service ground) for Telecommunications (TBC): Insulated grounding wire with a minimum copper conductor size equal to that of the TBB, with PVC insulation. Shall be UL listed.
 - 1. Specifications
 - a. Shall be copper.
 - b. Insulated grounding wire with PVC insulation
 - c. A minimum copper conductor size equal to that of the largest TBB or other bonding conductor connected to the PBB, UON.
 - d. Cable jacket marking: Shall be legible and shall contain the following information:
 - 1) Manufacturer's name
 - 2) Copper Conductor Gauge
 - 3) NRTL listing information
 - e. Cable jacket shall be green with black lettering
 - f. A minimum conductor size as indicated on drawings
- F. Ground Wire (for connections within each Telecommunications Room and to Cable Tray)
 - 1. Specifications
 - a. Shall be copper.
 - b. When not routed through plenum or other air-handling space: Insulated grounding wire with a minimum copper conductor size of number 6 AWG, with PVC insulation. Shall be UL listed.
 - c. When routed through plenum or other air-handling space: Non-Insulated grounding wire with a minimum copper conductor size of number 6 AWG. Shall be UL listed.
 - d. Cable jacket marking: Shall be legible and shall contain the following information:
 - 1) Manufacturer's name.

- 2) Copper Conductor Gauge.
- 3) UL listing.
- e. Cable jacket shall be green with black lettering.
- G. Connectors / Connections
 - 1. Specifications
 - a. All connectors and connections shall utilize products that are Listed by a NRTL such as UL.
 - b. All connectors shall have twin clamping elements for cable; two holes for attachment to grounding bar, etc.
 - 2. Compression Lugs
 - a. Specifications
 - 1) Shall be manufactured from electro-plated tinned copper for use with copper conductors.
 - 2) Shall include inspection port.
 - 3) On center dimension between holes (O.C. Dim. B/T Holes) shall be 0.625" ("A" Pattern) or 1" ("C" Pattern)
 - b. Manufacturer shall be:
 - 1) Harger GECLB Series
 - 2) Or Approved Equivalent
 - 3. Conductor to conductor connection
 - a. Specifications
 - 1) All connections between conductor and the joining or mating of cables to connectors shall be done by exothermic weld or irreversible compression connector.
 - b. Manufacturer Exothermic Weld
 - 1) Erico CADWELD
 - 2) Harger Ultraweld
 - 3) Or Approved Equivalent
 - c. Manufacturer Irreversible Compression connector

- 1) Burndy HYGROUND
- 2) Or Approved Equivalent
- 4. Connector for conduit to cable
 - a. Specifications
 - 1) All continuous conduits (except entrance conduits) which extend into the Telecommunications Room shall be fitted with a pipe clamp or conduit bonding clamp connected to the PBB/SBB.
 - b. Manufacturer shall be:
 - 1) For 1" diameter and larger conduits Harger series CPC electro tin-plated pipe lamp
 - 2) For less than 1" diameter conduits Harger TBGC4SCS elctro tin-plated conduit bonding clamps
 - 3) Or Approved Equivalent
- 5. Connector for conductor to cable tray
 - a. Specifications
 - 1) For metallic cable trays that extend to the Telecommunications Room.
 - b. Manufacturer shall be:
 - 1) Harger electro tin-plated cable tray bonding clamps TBCTC
 - 2) Or Approved Equivalent
- H. Insulated Grounding Bushings
 - 1. Specifications
 - a. All communications entrance conduits that extend into the Telecommunications Room shall be fitted with an Insulated Grounding Bushing.
 - b. Shall be UL Listed for copper conductors.
 - c. Shall include lug for easy connection of conductor to PBB/SBB.
 - 2. Manufacturer shall be:
 - a. O-Z/Gedney IBC-L
 - b. Or Approved Equivalent

2.2 PLYWOOD BACKBOARD

- A. 4' x 8' sheets of 3/4" thick (minimum) A-C grade plywood be securely fastened to the supporting walls as indicated on the plans.
 - 1. Plywood shall be installed with "A" side facing the interior of the room.
 - 2. Plywood shall be fire-retardant with stamp visible when installed, painted white with a minimum of two coats of fire-retardant paint with two coats of white paint with the exception of the stamped area indicating that it is fire-retardant].
 - 3. Plywood shall be mounted at 6" AFF and extend to 8'6" AFF.

2.3 TELECOMMUNICATIONS ENTRANCE PROTECTION

- A. Surge Protection
 - 1. The following manufacturers are Conditionally Approved:
 - a. Circa Telecom
 - b. Emerson Network Power
 - c. ITWLinx
 - d. TII Network Technologies
 - e. Or Approved Substitution (submitted and accepted in the "pre-bid" phase)
 - 2. Horizontal Cable Surge Protectors for 4-pair, Category 6A horizontal cables that serve outlets exterior the footprint of the building, including, but not limited to, cables serving outlets that are mounted on roofs, exterior walls, light poles, and emergency phones/towers.
 - a. Requirements
 - 1) Shall meet UL 497
 - 2) Shall exceed TIA 568 Category 6A performance standards
 - 3) Shall be capable of being used with POE+ applications
 - b. Wall-mount Protectors for single cables, where quantity of cables in Equipment Room needing protection is 6 or less
 - 1) Manufacturer shall be:
 - a) Emerson Edco CAT6A-POE
 - b) ITWLinx SurgeGate Series CAT6A-LAN

- c. Rack-mount Protectors where more than 6 cables in an Equipment Room require surge protection
 - 1) Shall be rack-mountable in 19" wide equipment rack
 - 2) Provide quantity of Category 6 protectors/modules required for install, plus 25% spare
 - 3) Manufacturer shall be:
 - a) APC ProtectNet Chassis (PRM24) with Cat 6 Surge Modules (PNETR6)
 - b) Emerson Edco RM-CAT6-**POE
- d. Far-end Protection: Wherever connected devices (such as cameras) do not have integral protection, provide the following at the far-end of the cable:
 - 1) Blackbox CAT6 In-Line Surge Protector
 - 2) Emerson CAT6-5POE-FF

2.4 TELECOMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES

- A. Two-Post Floor Rack
 - 1. The following manufacturers are Conditionally Approved:
 - a. Eaton Bline Series, model SB556084XUFB.
 - b. Or Approved Substitution (submitted and accepted in the "pre-bid" phase by City of Lee's Summit)
 - 2. Requirements
 - a. Approximately 7'-0" in height with 45U available to mount panels/equipment.
 - b. Mounting rails shall be spaced 19" wide per ECA EIA/ECA-310-E. Mounting rails shall contain 0.375" square holes of universal server mounting. Mounting rails shall contain front and rear flange mounting holes for panels/equipment.
 - c. Two-post rack shall be aluminum construction, 11 gauge and have a self-supporting base.
 - d. Finish shall be black.
 - e. Minimum static load capacity: 1,000 lb
 - f. UL Listed

- g. Secure rack to floor. Provide rack manufacturer's rack installation kit matching floor type of rack installation for a complete system meeting drawings and manufacturer instructions. Raised floor racks shall be mounted to sub or base floor with 5/8" threaded rods and steel brackets.
- h. Provide 6" stand-off bracket accessory on top of rack to mount ladder rack.
- i. Provide free standing relay rack accessories: rack base insulator kit, rack line-up spacer kit, rack base dust cover, equipment support bracket, equipment guard rail, and RMU Label Kit for a complete system meeting drawings and manufacturer instructions.
- j. Mount Grounding Isolation pad between equipment rack and concrete slab, prior to bolting equipment rack to slab. Isolation pad by B-Line SB-2545-01 or equivalent.
- B. Swing Wall Rack
 - 1. The following manufacturers are Conditionally Approved:
 - a. APC
 - b. B-Line
 - c. Chatsworth Products
 - d. Great Lakes
 - e. Hoffman
 - f. Middle Atlantic
 - g. Or Approved Substitution (submitted and accepted in the "pre-bid" phase)
 - 2. Requirements
 - a. Approximately 5'-8" in height with 35U available to mount panels/equipment.
 - b. Mounting rails shall be spaced 19" wide per ECA-310-E. Mounting rails shall contain 0.375" square holes of universal server mounting. Mounting rails shall contain front and rear flange mounting holes for panels/equipment.
 - c. Swing wall rack shall be minimum 14-gauge carbon steel construction and have a self-supporting base.
 - d. Finish shall be durable powder coat in black .
 - e. Minimum static load capacity: 300 lb.
 - f. UL Listed
 - g. Secure rack to wall. Install rack per manufacturer's hardware requirements and installation instructions for wall type.

- h. Provide rack accessories such as fan kits with (2) 6'' exhaust fans, fan guards and vent blockers (Model # DWR-FK6-26+ VBK-E20), bonding kit PET-K-D/EWR and keylock for a complete system meeting drawings and manufacturer instructions.
- i. Wall rack depth shall be 26"
- 3. Product shall be :
 - a. Middle Atlantic, DWR series, model DWR-35-26.

2.5 TELECOMMUNICATIONS TERMINATION BLOCKS AND PATCH PANELS

- A. General
 - 1. All telecommunications termination blocks and patch panels shall be by the same manufacturer and covered under the same Advanced Structured Cabling System Warranty.
 - a. The following manufacturers are Conditionally Approved:
 - b. Owner's standard manufacturer : Mohawk, Leviton/Berk-Tek, CommScope, Belden, Krone
 - c. Or Approved Substitution (submitted and accepted in the "pre-bid" phase by City Lee Summit)
- B. Rack-mount Modular Copper Patch Panels
 - 1. General Requirements for Patch Panels: Comply with referenced standards. Cables shall be terminated with connecting hardware of same category or higher.
 - 2. Patch panels shall be provided complete with all mounting hardware, jacks, retainers, wire guides, designation strips, etc.
 - 3. Patch panels shall accept modular jacks of exactly one port, and this modular jack shall be the same type as being installed at the far-end faceplates.
 - 4. Provide enough ports for the number of cables terminated on the patch panel, plus 25 percent spare. Provide all connector blocks', including plugs and jacks where required to fill each panel completely. Do not leave any blank openings.
 - 5. Modular Patch Panels shall be of a metal design with snap in module frames for each individual jack.
 - 6. Ports and panels shall be easy to identify with label holders for machine-printed and colorcoded labels. Rack mountable patch panels shall mount to standard EIA 19" racks.
 - 7. Patch panel shall be 19" rack-mount, 48-port, 2 rack spaces (3.5")
 - 8. Horizontal Cabling

- a. Four-pair Augmented Category 6 UTP cabling shall be terminated onto a four-pair Augmented Category 6 jack module. All jack modules shall be terminated using the T568B wiring scheme. The eight-position jack module shall exceed the connector requirements of the TIA Augmented Category 6 standard.
- 9. Submit Manufacturer and part number as part of pre-construction submittals.
- C. Rack-mount Optical Fiber Panels
 - 1. Fully enclosed cable management type patch panel. Rack mountable in equipment cabinets/racks. Front and rear access (front access only for wall mounted). Complete with all necessary cable clamps, couplings and connector bulkheads.
 - a. Optical fiber cables shall be terminated in cable management trays/modules.
 - b. Cable management module/tray can accommodate optical fiber patch cable. Tray/module shall provide a means to avoid exceeding the cable manufacturer's minimum bending radius to protect against crimping or over bending.
 - c. Cable management tray shall have labeling on the front of the tray.
 - d. Optical fiber patch panels shall have a plexiglass latching front panel. Labeling and connectors shall be clearly visible with front panel open or closed.
 - e. Optical fiber patch panels shall accept a variety of inter-changeable bulkheads including ST, SC, LC, FDDI as well as attenuators.
 - f. Optical fiber patch panels shall provide a splice tray option.
 - g. Fiber optic enclosures shall be 19" rack-mount and 2 rack units (3.5") in height. The enclosure shall be equipped for pigtail connector splicing and installation, and provide a crossover pathway for optical fiber jumpers using LC connectors for single mode fiber.
 - 2. Optical fiber termination method(s)
 - a. Factory-terminated pigtail and with fusion splice
 - b. Single-mode connectors:
 - 1) Simplex single mode LC connectors and adapters. Color shall be blue. Suitable for use with specified single-mode optical fiber. Maximum insertion loss across mated pair: less than 0.75dB.
 - 3. Submit Manufacturer and part number as part of pre-construction submittals.
- 2.6 TELECOMMUNICATIONS PATCH CABLES & CROSS-CONNECT WIRES
 - A. General

- 1. Supply all necessary patch cables and cross-connect wires as part of a complete and functioning telecommunications system to support voice, data, audio-video, security, and other miscellaneous systems.
- 2. The manufacturer of patch cables shall be the same as the telecommunications connectivity, unless otherwise specified.
- 3. All patch cables shall be factory-terminated and tested.
- B. Copper Cross-Connect Wires
 - 1. Provide cross-connect wires as indicated on the drawings and as required to form a complete and functioning telecommunications system. This includes extension of analog voice lines from the service provider demarcation point to the following connections:
 - a. Fire Alarm Control Panels
 - b. Emergency analog phone locations
 - c. Security Panels
 - 2. Manufacturer shall be:
 - a. Same as copper connectivity or backbone cabling manufacturer
 - b. Submit product cutsheet for review
- C. Copper Patch Cords
 - 1. Category performance shall be the same as copper patch panels.
 - 2. Cable shall be 4-pair, twisted pair with factory-terminated RJ-45 modules on each end.
 - 3. Provide (furnish and install) all patch cords required for the following connections and systems (coordinate color, length, and quantity with sub-contractors of those systems):
 - a. Fire Alarm Control Panels
 - b. Emergency analog phone locations
 - c. LAN connections for Audio-Video Systems equipment
 - d. LAN connections Security Systems equipment and cameras
 - 4. Furnish patch cords to the Owner prior to substantial completion in the following lengths and quantities:
 - a. Total quantity shall be 100% of the terminated ports, in the following colors and lengths:
 - 1) One-fourth shall be 3' and yellow

- 2) One-fourth shall be 3' and blue
- 3) One-fourth shall be 3' and Grey
- 4) One-fourth shall be 10' and blue
- 5. Manufacturer shall be:
 - a. Same as copper connectivity manufacturer
 - b. Submit product cutsheet for review
- D. Copper Station Cables
 - 1. For use at Telecommunications Work Area Outlets
 - 2. Same specification as Copper Patch Cords
 - 3. Cable shall be 4-pair, twisted pair with factory-terminated RJ-45 modules on each end.
 - 4. Furnish patch cords to the Owner prior to substantial completion in the following lengths and quantities:
 - a. Total quantity shall be 100% of the terminated ports, in the following colors and lengths:
 - 1) One-fourth shall be 25' and black
 - 2) Half shall be 10' and white
 - 3) One-fourth shall be 3' and yellow
 - 5. Manufacturer shall be:
 - a. Same as copper connectivity manufacturer
 - b. Submit product cutsheet for review
- E. Fiber Optic Patch Cords
 - 1. Singlemode
 - a. Connectors shall be LC on both ends.
 - b. Furnish patch cords to the Owner prior to substantial completion in the following lengths and quantities:
 - 1) Total quantity shall be 50% of the terminated ports, in the following lengths:
 - a) All shall be 7'-0"

- c. Manufacturer shall be:
 - 1) Same as fiber connectivity manufacturer
 - 2) Submit product cutsheet for review

2.7 TELECOMMUNICATIONS CABLE MANAGEMENT AND LADDER RACK

- A. Ladder Rack (Cable Runway)
 - 1. Color: black
 - 2. Rung Spacing: 9"
 - 3. Width: 18"
 - 4. UL Listed as an equipment grounding conductor
 - 5. Provide ladder rack components such as e-bend, outside radius bend, and corner bracket for a complete system meeting drawings and manufacturer instructions.
 - 6. Provide ladder rack supports such as wall angle support kit, triangular support bracket, center support kit, threaded rod, I-beam clamp, threaded ceiling kit, cabinet elevation kit, foot kit, rack mounting plate, rack elevation kit for a complete system meeting drawings and manufacturer instructions.
 - 7. Provide ladder rack accessories such as cross member radius drop, end caps, and dividers for a complete system meeting drawings and manufacturer instructions.
 - 8. The following manufacturers are Conditionally Approved:
 - a. B-Line
 - b. Chatsworth Products
 - c. nVent/Hoffman
 - d. Middle Atlantic
 - e. Or connectivity manufacturer carrying structured cabling warranty
 - f. Or Approved Substitution (submitted and accepted in the "pre-bid" phase)

B. Vertical Cable Managers

- 1. Manufacturer shall be the same as equipment racks and cabinets, unless otherwise noted.
- 2. Color: black
- 3. Size: as specified on drawings, or a minimum of 6" wide by 6" deep, whichever is greater.

- 4. The following manufacturers are Conditionally Approved:
 - a. B-Line
 - b. Chatsworth Products
 - c. Ortronics
 - d. Panduit
 - e. Or connectivity manufacturer carrying structured cabling warranty
 - f. Or Approved Substitution (submitted and accepted in the "pre-bid" phase)
- C. Horizontal Cable Management
 - 1. Manufacturer shall be .
 - 2. Color: black
 - 3. 2RU, above and below each flat 48-port patch panel, as shown on the drawings.
 - 4. The following manufacturers are Conditionally Approved:
 - a. Panduit NCMH2
 - b. Or Approved Substitution (submitted and accepted in the "pre-bid" phase by City of Lee's Summit)

2.8 POWER EQUIPMENT FOR CABINETS, RACKS, AND ENCLOSURES

- A. Horizontal Power Strip
 - 1. Shall operate at 120V AC / 60Hz.
 - 2. Shall include a minimum of 8 rear -facing NEMA 5-15R outlets.
 - 3. Shall be 1RU high and mount into standard 19" wide equipment rack.
 - 4. Shall have 15A capacity with surge suppression on all outlets.
 - 5. Provide one per equipment rack
 - 6. Manufacturer shall be:
 - a. APC AP9562
 - b. Chatsworth
 - c. Geist SP104-10
 - d. Middle Atlantic PD815RA-PL

- B. Uninterruptible Power Supply
 - 1. UPS to be furnished and Installed by City of Lees Summit (ITS)_

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's instructions.

3.2 GROUNDING AND BONDING INSTALLATION

- A. General:
 - 1. Install all other ground conductors (wire) without splices or mechanical couplers installed between the wire points of origin and termination except as shown on the Drawings and/or specified herein. Where splices are necessary, the number of splices should be a minimum and they shall be accessible and located in Telecommunications rooms (spaces). Joined segments of a TBB shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage. "Daisy chaining" of Telecommunications ground bus bars back to the PBB will not be accepted unless specifically indicated on the Telecommunications drawings or specified herein
 - 2. Unless otherwise noted, all ground wires shall be routed through the Telecommunications cable management pathways so as to achieve a "coupled bonding conductor" effect
 - 3. Where insulated conductors are necessary provide adequately rated insulation jackets or pathways to meet all required building codes. (I.e. Plenum, riser, outside plant, run entirely in conduit, etc.)
 - 4. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in ferrous metallic conduit that exceeds 3 feet (1 meter) in length, the conductors shall be bonded to each end of the conduit using a grounding bushing or a No. 6 AWG conductor, minimum.
 - 5. The Telecommunications Bonding Conductor (TBC), each Telecommunications bonding backbone (TBB) conductor, and each Backbone bonding conductor (BBC shall be green or marked with a distinctive green color
 - a. Marking with a distinctive green color Shall be done at a minimum of every 1 foot (0.3 meter) by appropriate methods
 - b. Indicate proposed and actual routing of these conductors on overall floor plans in both the pre-construction Shop Drawings and Record Drawings, respectively.
 - 6. Follow additional installation requirements from NECA/BICSI 607-2011 "Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings".

- B. Required Grounding Connections:
 - 1. Provide and install one individual ground wire from each equipment rack/cabinet/frame (installed under this work) to the SBB in the room. Each conductor is to be "home run"; do not "daisy chain" the connections, except as may be indicated on the drawings.
 - 2. Provide and install one individual ground wire from the raised floor system (if applicable) to the PBB. Conductor is to be "home run"; do not "daisy chain" the connections, except as may be indicated on the drawings.
 - 3. Provide and install one individual ground wire from the overhead and vertical ladder racking (installed under this work) to the SBB in the room. All sections of ladder rack shall be securely connected together; otherwise, provide ground wire from each section of ladder rack.
 - 4. Where structural steel is available for connection install one individual ground wire to the nearest structural steel for connection.
 - 5. Provide and install all grounding connections as required by Telecommunications set of drawings.
- C. Connector Installation:
 - 1. Provide all ground wire connectors as shown on the Drawings or as indicated herein, unless otherwise noted.
 - 2. Follow the connector manufacturer's instructions for installing the connector to the cable and the connector to the cabinet/rack, ground bar, etc. Use the appropriate tools for the job, tighten nuts/bolts to proper torque, remove paint, insulation, oxidation as needed to assure good metal to metal contact, etc. If the manufacturer does not provide tightening specifications, follow the recommendations of UL Standard 486.
- D. Cable Identification:
 - 1. Label both ends of each ground conductor within 6 inches (152.4 mm) of a connector terminal or splice. Label the grounding conductors as shown on the Drawings or specified herein. All labels shall include the following in addition to specific labeling requirements for each conductor.

IF THIS CONNECTOR OR CABLE IS LOOSE OR MUST BE REMOVED, PLEASE CALL THE BUILDING TELECOMMUNICATIONS MANAGER

- E. Quantities of Ground Wires (Conductors)
 - 1. Location and placement of grounding and bonding wires and components shall be as shown on the Drawings or defined herein.

- 2. Quantities of ground wires, bonding components, etc. shown on the drawings are illustrative only and are meant to indicate the general configuration of the work. Provide the correct quantities of materials to construct a grounding and bonding system that meets the intent of these Specifications and the relevant codes.
- F. Sizing of Ground Wires (Conductors)

Subject to the applicable electrical code and the reference standards and guidelines, the TBC, TBB, BBC conductors (if applicable), and conductors to serving electrical panels and building steel shall be sized per the following table (Table 1 from ANSI/TIA-607):

Linear Length (ft)	AWG Size	
less than 13	6	
14-20	4	
21-26	3	
27-33	2	
34-41	1	
42-52	1/0	
53-66	2/0	
67-84	3/0	
85-105	4/0	
106-125	250 kcmil	
126-150	300 kcmil	
151-175	350 kcmil	
176-250	500 kcmil	
251-300	600 kcmil	
Greater than 301	750 kcmil	

G. Testing

- 1. As a minimum test, as described below, all metallic wires and cables installed under these Specifications.
- 2. Test the grounding conductor and the terminal connectors for total resistance between the equipment item being grounded and the main telecommunications grounding point in the room. This resistance Shall be less than 0.10 Ohm.
- 3. Recommended test equipment (obtain approval of Owner/ Design Consultant prior to using substitute test equipment):
 - a. An ohmmeter capable of indicating resistance down to 10 milli-ohms or below.
- H. Acceptance
 - 1. Upon receipt of the Contractor's documentation of cable testing, the Owner/ Design Consultant will review/observe the installation and randomly request tests of the cables/wires installed. Once the testing has been completed and the Owner/ Design Consultant is satisfied that all work is in accordance with the Contract Documents, the Owner will notify the Contractor in writing.
- I. Record Drawings

1. The Project Record Drawings shall show the types and locations of installed grounding and bonding conductors.

3.3 TELECOMMUNICATIONS ENTRANCE PROTECTION INSTALLATION

- A. Fully protect each end of all incoming conductors which are considered to have lightning exposure in accordance with NEC chapter 8.
 - 1. Exception: Service providers will provide and install primary protectors on service entrance cabling.
- B. Install grounding wire as straight as possible from terminal to Grounding Bar.
- C. UON, mount all protection devices on wall surface in a manner sufficient to support the weight, and to sustain incidental contact.
- D. Protector housings shall stack vertically.
- E. Grounding and Bonding of Entrance Conduits
 - 1. Bond all metallic shields and armored jacketing material for all incoming cables as close as practicable to the entry into the building.
 - 2. Bonding conductors shall be connected to the appropriate bus bars as specified in this Section and in accordance with NEC chapter 8.
 - 3. Connect the grounding conductor from the protection devices directly to the PBB/SBB as specified in this Section and in accordance with the NEC and the manufacturers' recommendations.
 - 4. Verify grounding means exist at each end of the circuit as required by the NEC. If no grounding means exists then provide all connections required by the NEC.

3.4 TELECOMMUNICATIONS CABINETS, RACKS, FRAMES, AND ENCLOSURES INSTALLATION

- A. Wall cabinets, racks, frames, and enclosures shall be installed on a plywood backboard or attached to a masonry wall. The rack should not be attached to sheet rock (gypsum wall board).
- B. Tags/labels shall be placed on each equipment rack, cabinet and frame in accordance with specification Division 27 Section ""Common Work Results for Communications"

3.5 CABLE LADDER RACKING

- A. Installation and configuration shall conform to the requirements of the ANSI/TIA Standards 568C & 569, NFPA 70 (National Electrical Code), NEMA VE2, and applicable local codes.
- B. Install cable ladder racking level and plumb according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- C. Install cable ladder racking where indicated in the drawings and as required by these Specifications

- D. Corner clamp brackets shall be used to join sections of cable ladder rack that are perpendicular to each other.
- E. Cable ladder rack stringers shall be attached to plywood backboards with angle brackets and "J" bolts.
- F. End supports and stringer junction brackets shall be used to attach vertical cable ladder segments to the floor.
- G. Stringer junction brackets shall be used to attach end to end horizontal cable ladder rack segments.
- H. Open ended stringer segments shall be closed with corner clamps and end bars.
- I. Mounting plates and "J" bolts shall be used to attach the cable ladder racking to the relay racks or equipment cabinets.
- J. Runway should be supported every 4 feet on center with 5/8 diameter threaded rod with slotted hanger clamps, or applicable support brackets or attachments [unless more strict seismic supports are required. All wall brackets shall be attached to plywood backboard.
- K. A support shall also be placed within 24 in. on each side of any connection to a fitting.

3.6 CABLE MANAGEMENT AT EQUIPMENT RACKS AND CABINETS

- A. Install cable organizers and/or cable channel on equipment racks and within cabinets at locations as described in the Specifications and/or indicated on the Drawings.
- 3.7 QUANTITIES OF RACK/CABINET AND DISTRIBUTION FRAME EQUIPMENT AND COMPONENTS
 - A. Location and placement of communications equipment room fittings shall be as shown on the Drawings or defined in these specifications and schedules.
 - B. Quantities and sizes of communications equipment room fittings shown on the Drawings are illustrative only and are meant to indicate the general configuration of the work. Provide the correct quantities of all materials necessary to accommodate the work described in these specifications and schedules and shown on the Drawings.
 - C. Equipment racks, cabinets and distribution frames shall be assembled and installed as per the manufacturers' printed instructions.

END OF DOCUMENT 271100

DOCUMENT 271300 - COMMUNICATIONS BACKBONE CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a complete intra-building (premises) backbone cabling system in accordance with these Contract Documents. Including but not limited to, the following:
 - 1. Optical Fiber Cables
 - 2. Splices (where required by these Contract Documents)
 - 3. Necessary installation and supporting hardware.

1.2 RELATED SECTIONS INCLUDE THE FOLLOWING

- A. Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions, requirements, and recommendations in Division 27 Section "General Communications Requirements"
- B. Division 27 "Common Work Results for Communications"
- C. Division 27 "Structured Cabling System"
- D. Division 27 Section "Telecommunications Equipment Room Fittings"
- 1.3 BACKBONE CABLING DESCRIPTION
 - A. Backbone cabling system shall provide interconnections between communications equipment rooms, main terminal space, and entrance facilities in the telecommunications cabling system structure. Cabling system consists of backbone cables, intermediate and main cross-connects, mechanical terminations, and patch cords or jumpers used for backbone-to-backbone cross-connection.
 - B. Backbone cabling cross-connects may be located in communications equipment rooms or at entrance facilities. Bridged taps and splitters shall not be used as part of backbone cabling.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Backbone cabling system shall comply with transmission standards in ANSI/TIA-568, when tested according to test procedures of this standard.

1.5 CODES, REFERENCES, AND STANDARDS

A. Follow all applicable codes, references, and standards listed in Division 27 Sections "General Communications Requirements" and "Structured Cabling System".

1.6 GUIDELINES

A. Follow all applicable guidelines listed in Division 27 Sections "General Communications Requirements" and "Structured Cabling System".

1.7 QUALITY ASSURANCE

A. Refer to Division 27 Section "Structured Cabling System" for Quality Assurance requirements.

1.8 SUBMITTALS

- A. Follow the requirements for submittals in Division 27 Section "General Communications Requirements", as well as the detailed Submittal requirements in Section "Structured Cabling System". The following additional items shall be submitted:
- B. Pre-Bid Phase:
 - 1. For all products for which a substitute is to be considered as an approved equivalent or acceptable substitution provide submittals with sufficient detail for review by the Engineer. Submittals shall at a minimum provide detailed information substantiating all performance requirements as well as all necessary code compliance and NRTL listing information.
- C. Bid phase:
 - 1. Unit Pricing:
 - a. Optical Fiber Backbone:
 - 1) Supply unit pricing for the addition/deletion of individual indoor and outdoor strand, 12 strand, 24 strands and cable splices including connectors, closures, testing, etc.
 - 2) Supply unit pricing for the addition/deletion of individual multi-mode connectorization including connectors (pig-tails and splices, if used) and testing.
 - 3) Supply unit pricing for the addition/deletion of individual single-mode connectorization including connectors (pig-tails and splices, if used) and testing.
- D. "Pre-construction" submittal:
 - 1. Shop Drawings:
 - a. Submit for review scaled layout drawings showing the routing of all backbone cabling, with pair/strand counts, cable types, type of pathway (cable tray, j-hooks, conduit, firestopping device) and proposed cable identifiers indicated for each cable. Ideally, this information would be indicated on scaled overall plans for each floor; however, it is permissible to combine with other Structured Cabling System shop drawings for individual areas.
 - 2. Provide a typed list indicating part name, manufacturer, part number, and color (if applicable) for products specifically identified herein by the exact and complete part number (no wild-card characters).
 - 3. Submit manufacturers' cut sheets or catalog cut sheets for:
 - a. Each of the cables specified:

- 1) Cut sheets shall include the following information at a minimum:
 - a) Manufacturers name and logo
 - b) Cable outside diameter
 - c) Number of conductors/strands in each cable and binder group
 - d) Gauge or strand thickness
 - e) Minimum transmission performance rating
 - f) Cable jacket material and rating
 - g) Maximum pulling tension
 - h) Jacket/Sheath color
 - i) Individual conductor or strand insulation colors
 - j) Minimum bend radius
 - i) During installation and post installation.
 - ii) As well as any additional information required by individual sections of this Division.
- E. "Project Completion" submittal:
 - 1. As-built Drawings:
 - a. Submit scaled layout drawings showing the routing of all backbone cabling, with pair/strand counts, cable types, type of pathway (cable tray, j-hooks, conduit, firestopping device) and final cable identifiers indicated for each cable. Ideally, this information would be indicated on scaled overall plans for each floor; however, it is permissible to combine with other Structured Cabling System Record Drawings for individual areas.

1.9 WARRANTIES

A. Provide manufacturer warranties as required in Division 27 Section "Structured Cabling System".

PART 2 - PRODUCTS

- A. Intra-building; cables that remain within the envelope/footprint of the building that are not installed within pathways defined to be in "wet" locations
 - 1. Requirements
 - a. Cable shall have an overall armor of steel or aluminum.

- b. Cable jacket shall be plenum (OFNP | OFCP) rated.
- c. Manufacturer shall be:
 - 1) Leviton /Berk-Tek PDPK024
 - 2) Commscope
 - 3) Belden
 - 4) Krone
 - 5) Mohawk
 - 6) Or equivalent from Conditionally Approved manufacturer listed above (subject to Advanced System Warranty requirements)

2.2 SINGLE MODE OPTICAL FIBER CABLE

- A. Requirements
 - 1. See Division 27 and backbone (riser) diagram(s) on the Drawings for required fiber counts.
 - 2. Cable shall meet the transformation performance and physical specifications of ANSI/TIA-568.
 - 3. Intra-building; cables that remain within the envelope/footprint of the building that are not installed within pathways defined to be in "wet" locations
- B. Intra-building; cables that remain within the envelope/footprint of the building that are installed within pathways defined to be in "wet" locations
 - 1. Manufacturer shall be:
 - a. Leviton /Berk-Tek LTP012
 - b. Commscope
 - c. Belden
 - d. Krone
 - e. Mohawk
 - f. Or equivalent from Conditionally Approved manufacturer listed above (subject to Advanced System Warranty requirements)
- C. Fiber Optic Specification as per LEE' Summit Specification Section 2 Fiber :
 - 1. General Requirements: Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacturing of the products.
- 2. All materials and equipment furnished shall be new, unused, and completely free from defects and poor workmanship. All fibers shall be glass and be manufactured by Lucent, Corning, or approved equal. All fiber shall be loose tube construction for outdoor installation.
- 3. Fiber Characteristics: All fibers in the cable must be usable fibers and meet required specifications.

Single-Mode Fiber <GB Rated Bandwidth>

- a. Typical core diameter: 8.3um
- b. Cladding diameter: 125 +1.0um by fiber end measurement
- c. Core-to-cladding offset: <1.0um
- d. Coating diameter: 250 +15um
- e. Attenuation uniformity: No point discontinuity shall be greater than 0.1 dB at either 1310nm or 1550nm. The coating shall be a layered UV cured acrylate applied by the fiber manufacturer. The coating shall be mechanically or chemically removable without damaging the fiber.
- 4. Fiber Specification Parameters
 - a. All fibers in the cable shall meet the requirements of this specification.
 - b. The change in attenuation at extreme operational temperatures for singlemode fibers shall not be greater than 0.20 dB/km at 1550 nm, with 80 percent of the measured values no greater than 0.10 dB/km at 1550 Nm. Attenuation of single mode fiber shall be less than 0.50 db/km at 1310 Nm.
 - c. Optical fibers shall be placed inside a loose buffer tube, minimum twelve (12) fibers per tube.
 - d. The buffer tubes will meet EIA/TIA-598, "Color coding of fiber optic cables."
 - e. Fillers shall be included in the cable core to lend symmetry to the cable cross section where needed.
 - f. The central anti-buckling member shall consist of a glass reinforced plastic rod. The purpose of the central member is to prevent buckling of the cable.
 - g. Buffer tubes shall be stranded around a central member. Acceptable techniques include the use of the reverse oscillation, or "SZ," stranding process.
 - h. The cable shall be of gel-free design fully water blocked using water-swellable yarns and tapes that are nonhygroscopic, nonnutritive to fungus, electrically

nonconductive, and homogeneous material. The material shall be free from dirt and foreign matters.

- i. All dielectric cables (with no armoring) shall be sheathed with medium density polyethylene. The minimum nominal jacket thickness shall be 1.4 mm. Jacketing material shall be applied directly over the tensile strength members and flooding compound. Cable jacketing shall utilize the newer designs to provide maximum flexibility without loss or appreciable dB attenuation.
- j. The jacket or sheath shall be marked with the manufacturer's name, the words "optical cable," the year of manufacture, number of fibers, type of fiber $\langle SM \rangle$, and sequential feet. The markings shall be repeated every 2 feet. The actual length of the cable shall be within -0/+1% of the length marking. The marking shall be in a contrasting color to the cable jacket. The height of the marking shall be approximately 2.5 mm.
- k. The maximum pulling tension shall be 600 pounds (2700 N) during installation. The Contractor shall discard the first 10 feet of pulled fiber as it may be damaged during pulling.
- 5. Manufacturer's Quality Assurance Provisions
 - a. All optical fibers shall be proof tested by the fiber's manufacturer at a minimum load of 100 KPSI.
 - b. All optical fibers shall be 100 percent attenuation tested at the manufacturer. The attenuation of each fiber shall be provided with each cable reel. The measured attenuation shall be for each frequency, both sets, 1310 and 1550 for single mode. The documentation provided with each spool shall be provided to the Engineer. The Contractor shall designate, on a copy of each print of this documentation, the location where each spool has been installed and provide this data to the Engineer.
- 6. Breakout/Fanout Kits: The breakout kit, used to terminate the individual fiber, shall provide for the separation and protection of the individual fibers with the buffer tubing and jacketing materials to facilitate direct connection to equipment. The breakout kit shall be housed in a termination enclosure.
- 7. The fanout kits used to terminate fibers within a buffer tube shall provide for the separation and protection of the individual fibers with the buffer tubing and jacketing materials. The fanout kit shall match the number of fibers within the buffer tube and be color coded to match the TIA/EIA 598 B fiber optic color code standard. The fanout kit shall be housed in a termination enclosure.
- 8. The breakout/fanout kits will be considered incidental to the termination of the fiber.
- 9. Connectors: Connectors for single-mode fibers shall be LC unless otherwise specified. Any connector for single-mode fiber shall be factory-manufactured assembly with a six-foot (6') pigtail to be fusion spliced to the fiber cable. Connectors will be considered incidental to the termination of the fiber.

- 10. Termination Enclosures: Termination enclosures shall be of either Corning WIC-04P wall mount or Panduit FAP6WBUDSCZ rack mount, or equal, to include all couplers to facilitate the fiber installation.
- 11. Patch Cords: Patch cords and pigtails shall be factory-manufactured assemblies and shall be fully compatible with the fiber interconnect cable and connecting modems and modules. The patch cords and pigtails shall be equipped with connectors as described herein and shall be either three feet (3') or six feet (6'), or as required to fit in length. The length shall be sized to preclude possible damage in the installation and of moving of equipment.
- 12. One (1) duplex type patch cord with matching connectors shall be supplied for every fiber optic cable entering and exiting each termination location, unless otherwise specified.

2.3 SPLICES (SPLICE CASES)

- A. In general, optical fiber cables are not to be spliced except where indicated otherwise in the Drawings and Specifications.
 - 1. Refer to Division 27 Section "Telecommunications Equipment Room Fittings" for splicing requirements integral to rack-mounted enclosures.
- B. Where splicing is indicated in the Drawings and Specifications, multi-mode and single-mode optical fiber cable splicing shall be fusion spliced. Provide splice case with trays to accommodate all fiber strands that enter case.
- C. Multi-mode and single-mode optical fiber cables shall be spliced at points indicated on the Drawings.
 - 1. End caps with hole configurations to meet cable sheath diameters without filters.
 - 2. Plugs for all unused end cap holes.
 - 3. Trays shall be used to hold all splices.
 - 4. Optical fiber cables shall be labeled between 6" and 12" from their entry to the splice case.
- D. Maximum allowable loss for splices is 0.3 db.
- E. Manufacturer shall be:
 - 1. Preformed Line Products Coyote Fiber Optic Closures series
 - 2. Or approved equivalent

PART 3 - EXECUTION

- 3.1 INSTALLATION, GENERAL
 - A. Install in accordance with manufacturer's instructions.

COMMUNICATIONS BACKBONE CABLING

3.2 CABLE INSTALLATION

- A. General:
 - 1. Place all backbone cabling in accordance with these specifications, on the Drawings and as indicated on any cable schedules.
 - 2. Install each cable as an uninterrupted conductor section between the designated termination points, unless otherwise directed by the cable installation specifications.
 - a. There shall be no splices or mechanical couplers installed between the cable points of origin and termination except as shown on the Drawings and/or specified herein.
 - b. There shall be no Bridged taps (multiple appearances of the same cable pairs at several distribution points) installed.
 - 3. Unless otherwise noted, all cables shall be routed through the building cable conduit/cable ladder system. Refer to the Telecommunications floor plan and detail drawings for the layout of the conduits, cable tray and cable ladder.
 - a. Backbone cables in which no portion of the cable jacket will be exposed when routed in a plenum or other air handling space, shall be riser rated (CMR, MPR, OFNR, or OFCR). Cables suitable for use in air plenums or other air handling spaces, and which meet the electrical/transmission specifications, are also acceptable for riser applications.
 - b. Backbone cables in which any portion of the cable jacket will be exposed when routed in an air plenum or other air handling space shall be plenum (CMP, MPP, OFNP, or OFCP) rated.
 - c. Backbone cables installed in "wet" locations as defined by the NEC or in these construction documents shall be suitable for installation in such environments and follow the installation requirements for outside plant cables as specified herein.
 - d. Backbone cables routed vertically within a Telecommunications Room shall be supported by velcro-attachment every 18" to vertically-mounted ladder rack or D-rings.
 - 4. Cables shall remain unattached to pathways or other cables and shall simply lay at rest on the supports provided by its pathway (including cable trays, wire basket, j-hooks, conduit, etc.). Wire ties, velcro straps, electrical tape or any other method shall not be used to attach cables to cable supports or to create cable bundles.
 - a. Except when supported by ladder racking or D-rings within each Telecommunications room, UON.
 - 5. All backbone cables running on ladder racking within all Telecommunications rooms throughout the building shall be neatly placed and secured to the horizontal and vertical ladder racking with cable lacing twine or nylon wire ties at intervals not to exceed every third rung plus all locations where the cable changes direction.

- 6. At the same time backbone cables are pulled into a conduit also install a pull cord to facilitate future cable pulls along those. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull cord.
- 7. Do not install kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
- 8. Where distance allows all backbone cables shall be provided with slack/service loops at each end of the cable. Each slack/service loop shall be:
 - a. A minimum of (10) feet in length, UNO
 - b. Configured in a loosely formed figure eight configuration (ie. not coiled)
- 9. Prior to using any cable pulling lubricants provide the Design Consultant with written documentation from the cable manufacturer supporting the cable manufacturers' acceptance of its use in compliance with all required warranties as part of these contract documents. The use of non-water based lubricants shall be provided when pulling PVC jacketed and all cables not suitable for contact with water.
- 10. Comply with all referenced standards and guidelines
- 11. Cables shall be masked, covered, or otherwise protected from being painted or coming in contact with any other substance that may degrade the performance or physical characteristics of the cable jacket or insulation over time.
- 12. Where backbone cabling has a shield or metallic member, the shield or metallic member shall be bonded to the PBB/SBB in accordance with ANSI/TIA-607 and BICSI/NECA 607-2011.
- B. Outside plant cable installation: for cables placed in "wet locations". These locations include but are not limited to; pathways that extend outside the envelope of the building such as aerial entrances, direct buried cables, underground conduits, conduits embedded in, or routed below a ground floor slab, etc.
 - 1. Unlisted cables shall transition to an indoor rated cable within 50' of the entrance point as required the NEC.
 - a. This 50' allowed by code is only to allow termination as close as practicable to the entrance point. Terminate all outdoor only (unlisted) cables at the closest point of entrance and transition to an indoor rated cable to extend to additional Telecommunications rooms (spaces)
 - 2. No portion of outdoor only (unlisted) cables may be installed with the cable jacket exposed in any plenum or other air handling spaces nor shall they be allowed to transition between different levels of the building.
 - 3. Where specifically allowed by these construction documents cable jackets rated for dual use by a NRTL, such as an indoor/outdoor rated cable may be used.

- a. These cables may be installed in locations within the building in which the cable jacket is appropriately rated to meet all applicable building codes.
- 4. Rigid metallic conduit shall be used to route outdoor (unlisted) cabling to within 50' of the transition point to indoor rated cabling in accordance with the NEC.
- 5. Cables which extend beyond the envelope/footprint of the building shall be installed with entrance protectors in accordance with Division 27 Section "Communications Equipment Room Fittings".

3.3 OPTICAL FIBER CABLE INSTALLATION

- A. General:
 - 1. Place all optical fiber backbone cabling in accordance with these specifications, and as indicated on the cable schedules and the Drawings.
 - 2. Splices between optical fiber cables are permitted only at those locations indicated on the Drawings.
 - 3. Splices between riser rated optical fiber cables and factory connectorized pigtails are permitted, but not required at each fiber termination location indicated on the Drawings. Pre-terminated riser cables meeting the material specifications may be utilized.
 - 4. Comply with all referenced standards and guidelines.
- B. Pre-installation testing:
 - 1. Optical fiber cables: Perform visible light continuity check on each fiber. If one end is not accessible: perform OTDR test to assure fiber continuity.
- C. Optical Fiber Backbone Cables:
 - 1. Place between the optical fiber Main Distribution Frame (MDF) and the Telecommunications rooms as noted in the cable schedules and the Drawings.
 - 2. Optical fiber cable is to be installed within inner duct at all locations where it is within nominal 4-inch conduit (not including short conduit sleeves.)
 - 3. Support optical fiber riser cables with suitable support grips. After being supported, the optical fiber cables will be routed over to the optical fiber patch panel in that particular Telecommunications room.

3.4 OPTICAL FIBER MAIN DISTRIBUTION FRAME

- A. Optical fiber cables shall be routed to the Fiber MDF from each of the Telecommunications Rooms via conduits, trays and riser sleeves. See the Drawings.
- B. Optical fiber cables shall enter the Fiber Distribution Frame from the top of the frame and then routed to the connector and splice modules/shelves.

3.5 CABLE IDENTIFICATION

- A. Label all backbone cabling with machine-printed labels according to the labeling scheme identified on the drawings. Where the drawings are silent, submit RFI through appropriate channels requesting labeling scheme.
- B. Cables shall be labeled within 6" at each end and within each pullbox.
- C. All cable labels shall be thermal-transfer type and utilize self-adhesive labels. The following are approved manufacturers:
 - 1. Brady, IDXPERT
 - 2. Hellermann Tyton, Spirit 2100
 - 3. Panduit LS9
 - 4. Or equivalent

3.6 CABLE TERMINATIONS

- A. Terminate all backbone cabling specified in accordance with Division 27 Section "Communications Equipment Room Fittings", No cables shall contain unterminated elements UON.
- 3.7 CABLE TESTING
 - A. Refer to Division 27 Section "Structured Cabling System" for testing requirements.
- 3.8 ACCEPTANCE
 - A. The Owner and Design Consultant reserves the right to observe the conduct of any or all portions of the testing process.
 - B. All cables that fail testing are to be corrected prior to substantial completion and acceptance by owner. Replace entire cable if bad pair or strand is found.

END OF DOCUMENT 271300

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:
 - 1. Walks.
 - B. Related Requirements:
 - 1. 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 ACTION SUBMITTALS
 - A. Product Data: For each type of product.
 - B. 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified ready-mix concrete manufacturer testing agency.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Curing compounds.
 - 4. Applied finish materials.
 - 5. Bonding agent or epoxy adhesive.
 - 6. Joint fillers.
- C. Material Test Reports: For each of the following:
 - 1. Aggregates.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 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 C1077 and ASTM E329 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.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.8 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:
 - 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 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 CONCRETE MATERIALS

- A. Concrete mix shall conform to KCMMB specifications for concrete pavement per City Standard Specifications. Submit concrete mix specifications for approval by Landscape Architect.
- B. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:
 - 1. Portland Cement: ASTM C150/C150M, gray white portland cement Type I Type II Type I/II Type III Type V.
 - 2. Fly Ash: ASTM C618, Class C or Class F.
 - 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
 - 4. Blended Hydraulic Cement: ASTM C595/C595M, Type IS, portland blastfurnace slag Type IP, portland-pozzolan Type IL, Portland-limestone Type IT, ternary blended cement.
- C. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S Class 4M Class 1N Insert class, 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 1 inch 3/4 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Air-Entraining Admixture: ASTM C260/C260M.
- E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
 - 1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
 - 2. Retarding Admixture: ASTM C494/C494M, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.

- 6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.
- F. Water: Potable and complying with ASTM C94/C94M.

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 burlappolyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. BASF Corporation; MasterKure ER 50 (Pre-2014: Confilm.
 - b. Bon Tool Co.; 32-301-B7 BonWay Evaporation Retarder.
 - c. Brickform; a division of Solomon Colors; Evaporation Retarder.
 - d. ChemMasters, Inc; Spray-Film.
 - e. Dayton Superior; AquaFilm Concentrate J74.
 - f. Euclid Chemical Company (The); an RPM company; Eucobar.
 - g. Kaufman Products, Inc; VaporAid.
 - h. Lambert Corporation; LAMBCO Skin.
 - i. Laticrete International, Inc.; E-CON.
 - j. Metalcrete Industries; Waterhold.
 - k. Nox-Crete Products Group; MONOFILM.
 - I. Sika Corporation; SikaFilm.
 - m. SpecChem, LLC; SpecFilm.
 - n. TK Products; TK-2120 TRI-FILM.
 - o. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.
 - p. W.R. Meadows, Inc; EVAPRE.
 - q. Insert manufacturer's name; product name or designation.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Anti-Hydro International, Inc; A-H Curing Compound #2 DR WB.
 - b. ChemMasters, Inc; Safe-Cure Clear DR.

- c. Dayton Superior; Clear Cure VOC J7WBClear Resin Cure J11WCure & Seal 309 EFCure & Seal 309 J18.
- d. Euclid Chemical Company (The); an RPM company; Aqua-Cure VOXDiamond Clear VOXKurez DR VOXKurez W VOX.
- e. Kaufman Products, Inc; DR Cure.
- f. Lambert Corporation; AQUA KURE CLEAR.
- g. Laticrete International, Inc.; L&M CURE R.
- h. Nox-Crete Products Group; Res-Cure DHRes-Cure DS.
- i. Right Pointe; Clear Water Resin.
- j. SpecChem, LLC; PaveCure Rez.
- k. TK Products; TK-2519 DC WB.
- I. Unitex by Dayton Superior; Hydroseal 18.
- m. Vexcon Chemicals Inc.; Certi-Vex Enviocure 100.
- n. W.R. Meadows, Inc; 1100-CLEAR SERIES.
- o. Insert manufacturer's name; product name or designation.

2.5 RELATED MATERIALS

- A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D8139, semirigid, closed-cell polypropylene foam in preformed strips.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types I and II, nonload bearing Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.6 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.
 - 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

- B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Pozzolan: 25 percent.
 - 2. Slag Cement: 50 percent.
 - 3. Combined Fly Ash or Pozzolan, and Slag Cement: 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, 1-1/2-inch Nominal Maximum Aggregate Size: 5-1/2 4-1/2 2-1/2 percent plus or minus 1-1/2 percent.
 - 2. Air Content, 1-inch Nominal Maximum Aggregate Size: 6 4-1/2 3 percent plus or minus 1-1/2 percent.
 - 3. Air Content, 3/4-inch Nominal Maximum Aggregate Size: 6 5 3-1/2 percent plus or minus 1-1/2 percent.
- D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 0.30 percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture high-range, water-reducing admixture high-range, water-reducing and retarding admixture plasticizing and retarding 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.
- F. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum W/C Ratio at Point of Placement: 0.45 0.50 Insert ratio.
 - 3. Slump Limit: Minimum of 3 to maximum of 5 inches.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M and ASTM C1116/C1116M. 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.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

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. Limit vehicle speed to 3 mph.
 - 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 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 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.

3.4 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. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 5. 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 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 at intervals of 50 feet unless otherwise 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 if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

- 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
- 6. 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. 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 the concrete thickness, as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 - 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 developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches either way from centers of dowels.
 - 3. Doweled Contraction 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.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface 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.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.6 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.
- 2. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.7 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-retaining-cover curing 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 moistureretaining 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.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will 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 C172/C172M shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each [100 cu. yd.] [5000 sq. ft.] or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressivestrength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C143/C143M; 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 C231/C231M, 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 C1064/C1064M; 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 C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 - 6. Compressive-Strength Tests: ASTM C39/C39M; 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 equals 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 Architect/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.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect/Engineer 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/Engineer.
- 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.

3.9 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 Architect/Engineer.
- B. Drill test cores, where directed by Architect/Engineer, 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

SECTION 321316 - DECORATIVE 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:
 - 1. Integral color concrete paving.
 - B. Related Requirements:
 - 1. Section 321313 "Concrete Paving" for cast-in-place concrete paving with other finishes, curbs and gutters, and stamped detectable warnings.
 - 2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within decorative concrete paving and in joints between decorative concrete paving and other 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 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each decorative concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer ready-mix concrete manufacturer.
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Curing compounds.
 - 4. Applied finish materials.
 - 5. Bonding agent or epoxy adhesive.
 - 6. Joint fillers.
- C. Material Test Reports: For each of the following:
 - 1. Aggregates.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative concrete paving systems.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution prior to beginning work.
 - 1. Build mockups of full-thickness sections of decorative concrete paving to demonstrate typical joints; surface color, pattern, and texture; curing; and standard of workmanship.
 - 2. Build mockups of decorative concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Landscape Architect and not less than 48 inches by 48 inches.
 - 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.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

1.8 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 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.

Final Development Plans

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 of a radius of 100 feet or less.
- B. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration indicated. Provide solid backing and form supports to ensure stability of textured form liners.
- C. 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 CONCRETE MATERIALS

- A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- B. Contractor shall use concrete mix used on-site for sidewalks. Mix shall be City approved mix for color concrete. Submit concrete mix specifications for approval by Landscape Architect.
- C. Integral Color Pigment: ASTM C979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. As shown on plans
 - b. Or approved equal.
- D. Water: Potable and complying with ASTM C94/C94M.

2.4 CURING AND SEALING MATERIALS

- A. Curing Paper: Nonstaining, waterproof paper, consisting of two layers of kraft paper cemented together and reinforced with fiber, and complying with ASTM C171.
- B. Vapor Retarding Membrane: 10 mil reinforced polyethylene.

- C. Curing Materials: As recommended by integral color concrete manufacturer for compatibility.
- D. Sealer: The Bomanite Company Hydrolock water-based, single component, penetrating concrete sealer installed per manufacturer recommendations and specifications.
- E. Slip-Resistance-Enhancing Additive: The Bomanite Company Sure Trac polymeric grit coating additive installed per manufacturer recommendations and specifications.

2.5 RELATED MATERIALS

- A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber or ASTM D8139, semirigid, closed-cell polypropylene foam in preformed strips.
- B. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy-Bonding Adhesive: ASTM C881, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. Types I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Polyethylene Film: ASTM D4397, 1 mil thick, clear.

2.6 CONCRETE MIXTURES

- A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties.
- B. 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.
- C. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

- 1. Fly Ash or Pozzolan: 25 percent.
- 2. Slag Cement: 50 percent.
- 3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- D. 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:
 - a. 5-1/2 4-1/2 2-1/2 percent plus or minus 1.5 percent for 1-1/2-inch nominal maximum aggregate size.
 - b. 6 4-1/2 3 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
 - c. 6 5 3-1/2 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size.
- E. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 0.30 percent by weight of cement.
- F. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture water-reducing and retarding admixture water-reducing and accelerating 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.
- G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- H. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): 4000 psi.
 - 2. Maximum W/C Ratio at Point of Placement: 0.50.
 - 3. Slump Limit: Minimum of 3 to maximum of 5 inches.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94. 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.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

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 decorative concrete paving to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase. Limit vehicle speed to 3 mph.
 - 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 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

3.3 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.

3.4 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. Butt Joints: Use bonding agent at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 - 4. 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 Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of 50 feet unless otherwise 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 if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

- 6. 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. 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 the concrete thickness, as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within 3 inches either way from centers of dowels.
 - 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 developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within 3 inches in both directions from centers of dowels.
 - 3. Doweled Contraction 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.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface 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.

3.6 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.

3.7 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 Compound: Apply immediately after final finishing. 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.
 - 1. Cure integrally colored concrete with curing compound.
 - 2. Cure concrete finished with pigmented mineral dry-shake hardener with a curing compound.
- F. Curing and Sealing 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. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.
- G. Curing Paper: Cure with unwrinkled curing paper in pieces large enough to cover the entire width and edges of slab. Do not lap sheets. Fold curing paper down over paving edges and secure with continuous banks of earth to prevent displacement or billowing due to wind. Immediately repair holes or tears in paper.

3.8 SEALER APPLICATION

- A. Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions. Allow first coat to dry before applying second coat, at 90 degrees to the direction of the first coat, using same application methods and rates.
 - 1. Begin sealing dry surface per manufacturer recommended timeframe after concrete placement.
 - 2. Allow stained concrete surfaces to dry before applying sealer.
 - 3. Thoroughly mix slip-resistance-enhancing additive into sealer before applying sealer according to manufacturer's written instructions. Stir sealer occasionally during application to maintain even distribution of additive.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Testing Services: Field inspection and testing will be performed under provisions of Section 014000.

C. Prepare test and inspection reports. Maintain records of placed concrete items. Record date, location of pour, quality, air temperature, and test samples taken.

3.10 REPAIR AND PROTECTION

- A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Detailing: Grind concrete "squeeze" left from tool placement. Color ground areas with slurry of color hardener mixed with water and bonding agent. Remove excess release agent with high-velocity blower.
- C. Protect decorative 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 decorative 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

SECTION 32 1373 - CONCRETE PAVING 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. Cold-applied joint sealants.
- 1.3 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.
- 1.4 INFORMATIONAL SUBMITTALS
 - A. Product Certificates: For each type of joint sealant and accessory.
- 1.5 QUALITY ASSURANCE
 - A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - B. Product Testing: Test joint sealants using a qualified testing agency.
- 1.6 FIELD CONDITIONS
 - A. Do not proceed with installation of joint sealants under the following conditions:

- 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
- 2. When joint substrates are wet.
- 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
- 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

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.
 - 1. Primers: Product recommended in writing by joint sealant manufacturer for adhesion of sealant to joint substrates indicated, as determined from sealant compatibility and adhesion tests and prior experience.
 - B. Colors of Exposed Joint Sealants: As selected by the Landscape Architect from manufacturer's full range for this characteristic. Submit color samples for review and approval.
 - C. Joint-Sealant Backer Materials: Non-staining; 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.
 - 1. Backer Strips for Cold Applied Sealants: ASTM D 5249; Type 2; of thickness and width required to control sealant depths, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.
 - 2. Round Backer Rods for Cold-Applied Sealants: ASTM D 5249, Type 3, of diameter and density required to control sealant depths and prevent bottom-side adhesion of sealant.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use T.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
- a. Meadows, W.R., Inc.; Pourthane NS.
- b. Dow Corning.
- c. Pecora Corporation; Urexpan NR-200.
- d. Sonneborn Building Products Div., ChemRex Inc.; SL2.
- e. L.M. Scofield Company, Lithoseal Trafficalk-3g.
- 2. Color:
 - a. Gray Concrete Dow Corning, 888 grey silicone, as approved by Landscape Architect.
 - b. Color concrete areas as selected by Landscape Architect from full range of manufacturer's standard colors.

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 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

SECTION 321400 - UNIT PAVING

- PART 1 GENERAL
- 1.1 SUMMARY
 - A. Section Includes:
 - 1. Concrete and clay pavers.
 - 2. Curbs and edge restraints.
 - B. Related Requirements:
 - 1. Section 321313 "Concrete Paving" for concrete base under unit pavers.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. For materials other than water and aggregates.
- B. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C136.
- C. Samples: Showing full range of colors, textures, and patterns available for each type of unit paver indicated and the following:
 - 1. Joint materials involving color selection.
- D. Shop Drawings: Showing dimensions, colors, paver sizes, and layout.
- 1.3 INFORMATIONAL SUBMITTALS
 - A. Qualification Data: For Installer.
 - B. 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.
 - C. 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.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified unit paving installer. Installer's [field supervisor] [personnel assigned to the Work] must have Concrete Paver Installer Certification from the Interlocking Concrete Pavement Institute (ICPI) with [one of] [both of] the following designations:
 - 1. Residential Paver Technician Designation.
 - 2. Commercial Paver Technician Designation.
- B. 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 in sizes approximately 72 inches long by 72 inches wide.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. 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.
- 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.

1.6 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.

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 PAVERS

A. As shown on plans.

2.3 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.

2.4 ACCESSORIES

A. Compressible Foam Filler: Preformed strips complying with ASTM D1056, Grade 2A1.

2.5 SAND SETTING-BED MATERIALS

- A. Concrete base: vehicular or pedestrian design per plans.
- 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. Polymeric Sand for Joints:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Techniseal.
 - b. Or approved equal.
 - 2. Provide manufacturer's full range of colors for selection by Landscape Architect.
- D. 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.
- E. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

2.6 SEALERS

A. Paver Sealer: Per paver manufacturer's recommendations and specifications. Provide product for approval by Landscape Architect prior to ordering.

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 and waterproofing protection is in place.

3.2 PREPARATION

A. Sweep concrete base to remove dirt, dust, debris, and loose particles.

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 plans.
- 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:
 - Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints unless otherwise indicated; where unfilled joints are indicated, provide temporary filler until paver installation is complete. 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. Install edge restraints before placing unit pavers.
 - 1. Install job-built concrete edge restraints to comply with requirements in Section 033000 "Cast-in-Place Concrete."

3.4 SAND SETTING-BED APPLICATIONS

- A. Install concrete base with weep holes per plans and specifications.
- B. Place drainage geotextile over weep holes, extending beyond weep holes at least 24 inches.
- C. 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.
- D. Treat leveling course with herbicide to inhibit growth of grass and weeds.

- E. 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.
- F. 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.
- G. Install polymeric sand per manufacturer's recommendation and specifications.
- H. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- I. Apply Landscape Architect approved paver sealer per manufacturer's recommendations and specifications.

END OF SECTION

SECTION 321813 - SYNTHETIC TURF SYSTEM SURFACING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide all labor, equipment, and materials to install synthetic turf and infill onto the project areas as indicated on the Drawings and in this specification. Work shall include but is not limited to:
 - 1. Review installation of Dynamic Stone base finish surface and survey certification documents provided to the Owner by the Base Contractor prior to commencing work in this specification section.
 - 2. Install synthetic turf surface including all seams and related finish work.
 - 3. Attach turf at perimeter nailer as indicated on the drawings and recommended by Manufacturer/vendor.
 - 4. Provide (8) year warranty for all Synthetic Turf components and installation.
 - 5. Provide Owner with turf maintenance training.
 - 6. Post Construction Testing / observation / maintenance

1.2 RELATED WORK

- A. Examine Contract Documents for Specification Sections that affect work of this Section.
 - 1. 033000 Cast-in-Place Concrete
 - 2. 321823 Synthetic Turf Subsurface and Drainage System

1.3 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern. Unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.
 - 1. Organizations and Governing Bodies
 - a. American Association of State Highway and Transportation Officials (AASHTO):
 - b. Occupational Safety and Health Administration (OSHA)
 - c. Department of Transportation Standard Specifications
 - d. American Society for Testing and Materials (ASTM)
 - e. Consumer Products Safety Commission (CPSC)

Final Development Plans

- f. Synthetic Turf Council (STC)
- g. American Sports Builders Association (ASBA)
- 2. ASTM Standard Test Methods
 - a. D1577 Standard Test Method for Linear Density of Textile Fiber
 - b. D5848 Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Covering
 - c. D418 Standard Test Method for Testing Pile Yarn Floor Covering Construction
 - d. D1338 Standard Test Method for Tuft Bind of Pile Yarn Floor Coverings
 - e. D1682 Standard Method of Test for Breaking Load and Elongation of Textile Fabrics
 - f. D5034 Standard Test Method of Breaking Strength and Elongation of Textile Fabrics (Grab Test)
 - g. F1015 Standard Test Method for Relative Abrasiveness of Synthetic Turf Playing Surfaces
 - h. F1551 Standard Test Methods for Water Permeability
 - i. D2859 Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials
 - j. F355 Standard Test Method for Shock-Absorbing Properties of Playing Surfaces
 - k. F1936 Standard Test Method for Shock-Absorbing Properties of North American Football Field Playing Systems as Measured in the Field
 - I. D1557 Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

1.4 DEFINITIONS

- A. Dynamic Stone Base & Topping Stone: Materials applied as part of the drainage system / base below the Synthetic Turf Surface System.
- B. Base Contractor The contractor who shall complete the preparation, construction and installation of the turf area finish subgrade, sub-drainage, turf perimeter nailer, dynamic base stone and finishing stone.
- C. Synthetic Turf Vendor The synthetic turf company/manufacturer who will provide all the materials and the warranty over the final product.
- D. Synthetic Turf Contractor The Company working for the Vendor who shall oversee the installation of the turf area surface and infill.
- E. Synthetic Turf Installer/Foreman/Superintendent The individual who will be on-site installing and overseeing the actual turf area installation.

1.5 SUBMITTALS

- A. Synthetic Turf Vendor Product Data and Certifications:
 - 1. Submit the fiber manufacturer's name, type of fiber and composition of fiber
 - 2. Submit manufacturer's specifications, installation instructions and care requirements for the synthetic turf, seaming system, glues, and infill materials.
 - 3. Submit letter and specifications sheet certifying that the products of this specification Section meet or exceed specified requirements.
- B. Synthetic Turf Vendor Material Samples and Test Reports:
 - 1. Synthetic Turf
 - a. Submit (3) samples of each product specified in this section with backing, approximately 7" x 11". Color and turf sample to be approved by Owner and or its representatives.
 - 2. Seams
 - a. Submit glued seam per manufacturers' recommendation.
 - b. Submit adhesives technical specification.
 - c. Submit (3) samples 11" long seaming tape.
 - 3. Certified copies of independent (third-party) ASTM laboratory reports (New/current) including but not limited to the following:
 - a. Impact Attenuation, Gmax F-355/F1936, Procedure A (system)
 - b. Average Tuft Height D5823
 - c. Total Fabric Weight without infill D5848
 - d. Average Pile Yarn Weight D5848
 - e. Pile Height, Face Width and Total Fabric Weight D5848 or D418
 - f. Primary & Secondary Backing Weights D5848 or D418
 - g. Tuft Bind without infill D1335
 - h. Grab Tear Strength D5034
 - i. Fiber Breaking Strength, Elongation Glued Seam Turf Sample D5034
 - j. Machine Gauge, Stitches per 3 inches D5793
 - k. Infiltration Rate BS7044 Method 4
 - I. Water Permeability with infill D4491
 - m. Yarn Denier ASTM D1907-07
 - n. Fiber Thickness D3218
 - o. Total Lead Content F2765-09
 - p. Accessibility of Surface F1951
- C. References / Successful Installations

- 1. Certified list of successful existing installations, including Owner representative and telephone number, attesting compliance with quality assurance information.
- D. Quality assurance information
 - 1. Submit to Owner for approval as delineated in Quality Assurance below in this Specification section.
- E. Qualifications Statements
 - 1. Submit experience requirements as described in the Quality Assurance portion of this specification.
- F. Supplier List
 - 1. Submit list of procured and contracted suppliers of all materials required for the Synthetic Turf System.
- G. Turf Vendor / Turf Contractor Review
 - 1. Turf Contractor to submit signed written statement on company letterhead, stating that the Drawings and Specifications have been reviewed by qualified representatives of the materials manufacturer, and that they are in agreement that the materials and system to be used for synthetic area surfacing are proper and adequate for the applications shown.
- H. Statement of Supervision
 - 1. Upon completion of the Work, Synthetic Turf Vendor to submit a signed written statement on company letterhead stating that the turf area supervision by the manufacturer's representative (Turf Contractor) was sufficient to ensure proper application of the complete system and materials, that the Work was installed in accordance with the Contract Documents, and that the installation is acceptable to the manufacturer.
- I. Synthetic Turf Product Safety Statement
 - 1. The Turf Vendor/Manufacturer shall submit a signed statement on company letterhead that provides certification through an independent testing source that the product being installed on the project complies with the United States Consumer Product Safety Commission's most stringent requirement for lead content (below 100 ppm) and is safe for use by all ages and to the environment.
- J. Warranty

- 1. Turf Vendor shall provide a sample written full labor and full materials warranty for the time duration and in compliance with the requirements of the Warranty/Guarantee section of this specification for the synthetic turf and infill.
- K. Delivery Slips
 - 1. The Turf Contractor to submit all delivery slips during construction for infill materials to assure that the proper ratio of sand is in general acceptance of the project requirements.
- L. Owner's Manual and Training
 - 1. Submit OM Manual as described in this specification.
 - 2. Include record document(s) showing actual locations of seams, drains or other pertinent information.
 - 3. Submit on a thumb drive a digital copy of the filmed Owner training.

1.6 QUALITY ASSURANCE

- A. Experience
 - 1. The experienced Synthetic Turf Installer shall have the following qualifications;
 - a. Minimum experience of at least 5 years, actively selling, installing and maintaining in-fill synthetic turf project of similar size.
 - b. Must have previously installed at least Fifteen (15) successful outdoor full sized (35,000 square feet or larger) synthetic turf infilled fields, play areas of similar material and infill within the past three (3) years.
 - c. Shall be an established, insured installation firm experienced as a premium, manufacturer certified turf installer with suitable equipment and supervisory personnel, with a minimum of 5 years' experience with 15-foot-wide tufted materials.
 - d. Shall be trained and certified, in writing, by the turf manufacturer, as competent in the installation of the specified material, including seaming and proper installation of the infill mixture.
 - 2. Synthetic turf shall be installed by only certified crews approved by the Synthetic Turf Manufacturer/Vendor and employed by the General Contractor, (if different) in strict accordance with manufacturer's recommendations and instructions including but not limited to fabric, adhesives, seaming and abutting or attaching to adjacent materials.
 - 3. The synthetic turf installer superintendent shall have supervised the installation of at least ten (10) outdoor systems of similar to this specified project within the last

three (3) year period. This foreman shall be directly employed by the Turf Installer/Contractor.

- a. Include a listing of other on-site personnel and their experience.
- 4. The Contractor shall not replace the named individuals for the duration of the contract unless the substitute individuals have equivalent qualifications as approved by the Owner.
- 5. The Synthetic Turf Contractor and the Synthetic Turf Manufacturer/Supplier must have been in business under the same ownership for at least three years and shall have been installing similar turf areas for that entire period.
- 1.7 QUALITY CONTROL
 - A. Source
 - 1. Obtain Synthetic Turf product including tufted or woven synthetic turf yarn, carpet backings and infill materials from a single Synthetic Turf Manufacturer.
 - 2. Provide additional system components including anchoring materials, seaming products, binders and adhesives, and resilient underlayment meeting the criteria of this Specification Section from single sources.
 - B. During Construction: Submit samples of each of the following during mass production of gravel materials for performance testing and prior to shipping.
 - 1. Infill Materials:
 - a. Random samples may be pulled from bulk packages or piles on-site at the discretion of the Owner or its representatives. Number of samples at the Owners discretion. The samples shall be tagged and marked from the packages for future reference after testing is complete. Sieve analysis testing results shall be compared to Vendor's previously submitted analysis for the infill materials for approval. Packages that do not meet approval shall be removed from site. Initial testing shall be paid for by the Contractor. Retesting shall be at the Contractors expense. Additional screening of materials by Contractor to remove fines may be required at Owners sole discretion at no additional cost to Owner.
 - 2. Environmental Conditions
 - a. Install synthetic turf surfacing only when ambient air temperature is 40 degrees F or above and the relative humidity is below 35% or as specified by the product manufacturer. Installation will not proceed if rain is imminent.
 - b. Install product only when prepared base is suitably free of dirt, dust, and petroleum products, is moisture free and sufficiently secured to prevent unwanted pedestrian and vehicular access.

Final Development Plans

- 3. Inspection / Acceptance
 - a. Installation of synthetic turf surfacing shall be done only after dynamic stone base, ground boxes, drainage, perimeter anchor, fencing and or other structures or construction work which might injure it has been completed. Damage caused to stone base finish grade or to the turf installation during construction shall be repaired prior to acceptance/Substantial Completion to the satisfaction of the Owner.
- 4. Protection
 - a. The Synthetic Turf Contractor shall be responsible for the protection of the synthetic turf surface and product after its' installation through Substantial Completion.

1.8 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered and stored within the Contractor's work limits or in an area approved by the Owner. Materials shall be inspected for damage immediately upon delivery.
- B. All material shall be stored in strict accordance with the manufacturer's recommendations.
- C. Special care shall be exercised during delivery and storage to avoid damage to the products.
- D. Packaged Materials:
 - 1. Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

1.9 PROJECT CONDITIONS

- A. Adhesives should not be applied within 12 hours after rainfall, or when rainfall is forecast.
- B. No part of the construction shall be conducted during a rainfall or when rainfall is imminent, or unless both ambient and materials temperatures are at least 40 degrees F and rising.
- 1.10 COMPLETION AND FINAL ACCEPTANCE

- A. Refer to 321823 Synthetic Turf Subsurface and Drainage System for Base Work completion items prior to commencement of Synthetic Turf Surface installation.
- B. General: Synthetic Turf area completion shall be separated into 2 phases, "Preliminary Completion" and "Substantial Completion."
- C. Preliminary Completion: Scheduled date for preliminary completion shall be at least 10 calendar days before Substantial Completion. Notify Owner and its representatives in writing, 7 days prior to scheduled date for observation for "Preliminary Completion." To be considered "Preliminarily Complete" the following items shall be provided and achieved:
 - 1. Items as previously installed and approved in Section 321823 Synthetic Turf Subsurface and Drainage System
 - a. Turf Installer also accepted this work as part of commencement of work scope in this specification section.
 - 2. Synthetic turf installed.
 - 3. Smooth, level playing surface level to grading tolerances.
 - 4. In ground accessories adjusted and set to finish grade.
 - a. Coordinated with Base Installer. Base Installer to adjust.
- D. Substantial Completion: After "Preliminary Completion" observation, the Landscape Architect/Engineer and Owner shall prepare and submit to the Contractor, a punch list of items to be completed to achieve "Substantial Completion". Contractor shall notify the Landscape Architect /Engineer and Owner in writing, 5 days prior to a requested date for a site observation to meet "Substantial Completion." To be considered "Substantially Complete" or "Playable" the following items shall be jointly provided by the Base Installer / Turf Installer / Turf Manufacturer:
 - 1. All "Preliminary Completion" punch list items are complete.
 - 2. Submit five (5) copies of written operating and maintenance instructions. Provide format and contents as directed by the Engineer. This should include all necessary instructions for the proper care and preventative maintenance of the synthetic turf system, including painting and markings. Also address remedial measures for graffiti removal.
 - 3. Submit (5) copies of all vendors and products used including websites, phone numbers and contacts.
 - 4. Submit (5) copies of all certified surveys performed during construction for Quality Control.
 - 5. Written warranties/guarantees with documentation that applicable forms have been completed in Owner's name and registered with the Manufacturer.
 - 6. Stockpiling or storage of required "attic stock" materials.
 - 7. Upon completion of the synthetic turf system surface, the contractor shall provide the Owner with 2 hours of maintenance training that shall be recorded on a video

tape and supplied to the Owner. Instruct the Team or Owner's personnel in the operation of the water and other systems.

1.11 WARRANTY/GUARANTEE – SYNTHETIC TURF SURFACE SYSTEM

- A. General: Warranties / Guarantees specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and are in addition to and run concurrent with other warranties/guarantees made by the Contractor under requirements of the Contract Documents.
- B. Installer/Manufacturer Guarantee: The President(s) of both the synthetic turf contractor and the synthetic turf manufacturer (if different) shall sign this document and it shall include the following:
 - 1. The turf product and its infill materials (defined as the turf system) shall be free from defects of material and workmanship for a period of fifteen (15) years from date of Substantial Completion. Defects shall include, but not be limited to ultraviolet ray fading, degradation, or excessive wear of fiber.
 - 2. Synthetic turf product as specified and represented by the Turf manufacturer/vendor.
 - 3. All materials and products as specified.
 - 4. Synthetic turf / infill / backing (turf surface system) shall be guaranteed to have a percolation rate (drain vertically) greater than 6 inches per hour without prolonged accumulation of surface water. If the synthetic turf system does not drain in accordance with this Specification, then punching the carpet backing or any method creating additional holes in the backing other than the designed drainage holes will not be permitted. The removal and replacement of the infill will be permitted given there is not damage to the fibers in the process.
 - 5. The synthetic turf materials shall not fade, (significant loss of color) fail, wrinkle or show excessive wear.
 - 6. The Warranty shall contain no usage limits for warranted turf system.
 - 7. The exposed turf surface shall not decrease more than 10% per year according to ASTM D5848, nor exceed 50% during the warranty period. Portions of the synthetic turf area that fail to meet these standards shall be replaced in both materials and labor by the Contractor.
 - 8. Turf product shall be adaptable to painted lines.
 - 9. Seams shall not separate, become unglued or detached.
 - 10. The entire turf system shall be resistant to weather, insects, rot, mildew and fungus growth and be non-allergenic and non-toxic.
 - 11. The entire turf system shall retain maximum dimensional stability, resist damage and provide normal wear for its designated use.
 - 12. Adhesives used shall be resistant to moisture, bacteria, fungus and resist ultraviolet rays.
 - 13. Guarantee shall include removal and replacement of materials (parts and labor) not performing to the standards described and as required to repair synthetic turf surfacing at no cost to the Owner.

- 14. Any defects will be remedied on written notice at no additional cost to the Owner.
- 15. The 8-year warranty shall not be prorated.

1.12 INFRINGEMENT / HOLD HARMLESS

- A. The synthetic turf manufacture and its installer(s) are responsible for ascertaining that means and methods of the products and services which they are providing are not being provided in violation of any patent rights held by their competitors or manufacturers of other products. Their responsibilities are as follows:
 - 1. The Synthetic Turf Vendor shall provide a signed letter on company letterhead holding the Owner, Owner's Representative and all other project consultants harmless for any violation of patent rights or infringement. The Contractor shall also cover the legal defense costs, turf replacement and any other costs (as applicable) incurred by the Owner and its representatives related to infringement of any current or future patent issued for the synthetic surfacing system.
 - 2. The Synthetic Turf Vendor shall provide a signed letter on company letterhead holding the Owner, Owner's Representative and all other project consultants harmless for lawsuits that may occur due to the product manufacture or make up in regard to health and safety.
 - 3. The Synthetic Turf Vendor shall bear any legal, material, service or other costs incurred to the Owner or its representative's due to any patent right infringements.
- B. If any product or services proposed to be provided by the Synthetic Turf Vendor and or its installers are known by them to be subject to any existing claims of infringement, Synthetic Turf Vendor and or its installers shall notify the Owner and the Owner's Representative of such claim and provide evidence of financial ability to perform on the above hold-harmless requirements.

PART 2 - PRODUCTS

2.1 EARTHWORK MATERIALS

- A. Work performed prior to installation of Synthetic Turf Surface.
- B. Earthwork materials shall meet the requirements of Specification "Earth Moving" and "Synthetic Turf Subsurface and Drainage System".

2.2 PERIMETER TURF ANCHOR/NAILER

A. Work performed prior to installation of Synthetic Turf Surface and consisting of the perimeter turf anchor/nailer, located at the perimeter or turf edges. Turf Contractor to attach synthetic turf product to this perimeter nailer as specified in this specification.

2.3 SYNTHETIC TURF PRODUCT

- A. General:
 - 1. New outdoor Synthetic Turf System comprised of synthetic turf fibers tufted or woven into a backing, leaving height of exposed fiber per product as recommended and warranted by the manufacturer. The tufted synthetic turf is comprised of either nylon or polyethylene pile sewn into a polyurethane backing.
 - 2. Selection of these products represents the required minimum performance criteria as outlined herein. The manufacturer's performance criteria and product properties and declarations both physical and chemical are as represented by the manufacturers at the time of this solicitation. Approved equals must be pre-bid approved.
- B. Systems and Manufacturers:
 - 1. Turf Products
 - a. Turf Product Basis of Design: SYNBLUE 949
 - b. Or approved equal
 - 2. Turf Manufacturer
 - a. SynLawn:
- C. Appearance/Feel:
 - 1. The finished surface shall appear as mowed grass with no irregularities.
- D. Seams
 - 1. Either sewn or glued seams and as recommended, warranted and approved by the Turf Manufacturer.
 - 2. Glued seams
 - a. Adhesives for bonding tufted synthetic turf shall be as recommended and warranted by the synthetic turf manufacturer. Adhesives shall be one-part moisture cured polyurethane
 - 1) Nordot #34G (Synthetic Surfaces (908) 233-6803), Mapei 2G, or approved equal and as recommended by the Turf Manufacturer / Installer.
 - b. Work in adverse weather is discouraged. If necessary, Turf Installer / Vendor shall recommend amendments to the adhesive that if approved by the Owner and its representatives shall meet all requirements of the warranty and bear no cost implications to the Owner in materials or labor.

- E. Synthetic Turf Products and Physical Properties
 - 1. Turf Product: SynBlue 949 or approved equivalent
 - a. Roll Width: 15 ft
 - b. Grass Zone Yarn/Color: Polyethylene / Olive
 - c. Grass Zone Denier / ends: 9,900/ 9
 - d. Thatch Zone Yarn/Color: polyethylene / field green/beige blend
 - e. Thatch Zone Denier / ends: 5,000/8
 - f. Finished Pile Height: 1-7/8 inch
 - g. Face Weight: 90 oz / sq y
 - h. Total Fabric Weight: 118 oz / sq yd
 - i. Primary Backing Weight: 6oz / sq yd
 - j. Secondary Coating Weight: 22oz / sq yd
 - k. Tuft Bind: >8
 - I. Machine guage: 1/2- inch
 - m. Water Permeability: >400 inches / hr
 - n. Other Features: EnviroLoc, Heatblock, DeLuster, UV Stabilizers
 - o. Seaming: Micromechanical bonding
 - p. Infill: 1 lb. sand psf. required

2.4 SPARE PARTS/ATTIC STOCK

- A. Stockpile Materials: Provide the following additional materials stored as directed by the Owner.
 - 1. Turf: Material may be end of rolls or cutoffs. Minimum size of turf shall be 5 x 15. Provide the following minimum materials for each product and store as directed by the Owner.
 - a. Turf: 100 square feet for each product specified

PART 3 - EXECUTION

3.1 EXAMINATION AND PROTECTION

A. Verification of Conditions: Examine areas and conditions under which all work of this Section is being performed. Review certified survey submitted to the Owner by the Base Contractor for elevations on the finished topping stone. Use string lines or other procedures to verify uniformity of finish topping stone. Do not proceed with any work until unsatisfactory conditions have been corrected. Commencement of work implies acceptance of all areas and conditions.

- B. Protection of Work this Contract: Protect all on-going work, so as not to delay work due to weather or project related construction. This includes but is not limited to the use of tarps, geotextile, plywood and other protective measures.
- C. Protection of Persons and Property: Provide all necessary measures to protect workmen and passersby.
 - 1. Protect adjacent construction throughout the entire operation.
- D. Installation of synthetic surfacing shall be done only after excavation and construction work which might injure it has been completed. Damage caused during construction shall be repaired before acceptance.
- E. The Contractor shall coordinate the installation of the synthetic surface and the surrounding surfaces for optimum interface at all edges.

3.2 STONE BASE ACCEPTANCE

- A. The Turf installer shall submit a written statement of acceptance and acknowledgment of the following;
 - 1. On-site visual observation of the synthetic turf area. Installer should minimally observe overall planarity, overall area compaction, compaction at the turf anchor and perimeter condition.
 - 2. Review of the certified base stone survey(s) of the area submitted previously by the Base Contractor
 - a. Base Stone Tolerance Requirements: The final elevation of the finished stone base is plus or minus one quarter inch at any point on the install area and on a 25 foot by 25-foot grid grade as indicated on the Contract Drawings.
 - b. Finish Stone Base Certification: A certified survey by a State licensed land surveyor with elevations noted on a 25-foot grid to verify required grade and elevation tolerances of the subgrade. The digital survey document indicates spot elevations and tenth of foot contours and was submitted to the Engineer/Owner for review and approval prior to moving to next part of work.
 - 3. Acknowledgement that the stone base and drainage systems appear to be functioning properly prior to beginning work for this section.
- B. Commencement of turf prep and or placement of turf by the Turf Installer indicates acceptance of the stone installation and no claims for extra work based upon these conditions shall be accepted.
- 3.3 TURF INSTALLATION PREP / DYNAMIC STONE BASE FINISH

Final Development Plans

A. General

- 1. The Synthetic turf installer shall maintain benchmarks, required lines, levels, contours and datum already established by the Base Contractor and only enhancing them to allow for a premier installation of the carpet. Any touch up grading or manipulation of the surface required by the Turf installer is to be coordinated with the Owner and/or it representative and the Base Contractor (if different) and at no additional cost to the Owner.
- 2. If additional materials are required, only tested and approved stone materials from the original source and specification shall be used. Contract grading tolerances shall be met.

3.4 INSTALLATION OF SYNTHETIC TURF

- A. The installation of the Synthetic Turf product shall be performed in full compliance with the approved Shop Drawings and Manufacturers recommendations. Any variance from these requirements must be accepted in writing, by the Owner, verifying that the changes do not in any way affect the warranty.
- B. The Synthetic Turf Installer shall lay the turf system over the top of the dynamic base / topping stone previously approved and in place.
- C. Synthetic turf shall be installed by crews certified and or employed by the Synthetic Turf manufacturer, in strict accordance with manufacturer's recommendations and instructions including but not limited to, fabric, adhesives, seaming and abutting or attaching to adjacent materials.
- D. The synthetic turf carpet shall be installed with no wrinkles, ripples or bubbles. Shearing of fibers, slits in the fabric or driven spikes or staples to relieve such defects will not be permitted.
- E. Rolls that do not comply with the proper length or conform to the seaming diagram, as approved prior to installation, shall be rejected from the site. No fitted pieces shall be allowed to true alignment.
- F. Turf panel seams shall be glued with an adhesive as recommended by the synthetic turf manufacturer and installed per manufacturer's instructions. All seams shall be flat, tight and permanent with no separation or fraying.
- G. Glued seams shall only be installed in suitable weather conditions as per manufacturer's instructions and or warranty requirements. Any suggested modifications to the adhesive or methods used in unfavorable weather conditions shall be submitted with the full approval of the Turf Vendor to Owner and its representatives. This does not relinquish the responsibility of the Vendor or its installers from any warranty issues or claims throughout the warranty period.

H. The turf installer shall glue/nail the turf edges to the perimeter anchor system at the edge of the install area as well as to all collars around other in ground boxes or structures.

3.5 CLEAN UP

- A. Remove from the Owners property all surplus excavated material not required for filling and backfilling, trash, and debris and dispose of it properly at Contractor's expense.
- B. At the end of each day, remove all scraps and other debris created by the synthetic turf installation from the install area.
- C. At end of turf installation and just prior to punch list, contractor to use magnetic device/equipment to remove all metallic materials on install area caused by construction.

3.6 TRAINING

- A. As part of Substantial Completion, The Turf Vendor / Turf Contractor shall provide the Owner with synthetic turf maintenance training as required in this Specification Section.
- 3.7 FINAL SUBMITTALS
 - A. Refer to "Completion and Final Acceptance" Section in this Specification Section

END OF SECTION 321813

SECTION 321823 - SYNTHETIC TURF SUBSURFACE AND DRAINAGE SYSTEM

PART 1 - GENERAL

1.1 WORK NOT INCLUDED

A. The area for this installation is located on the top of a building structure and as part of an outdoor courtyard surrounded by a residential building. The concrete structure and the fill materials used to achieve subgrade (elevation below the turf system finish stone base) is being performed by others and prior to commencement of the synthetic turf system as described in this specification section and the synthetic turf system surface specification section.

1.2 WORK INCLUDED

- A. Provide all labor, equipment and materials, and do work necessary to construct the finish Dynamic Stone Base onto the synthetic turf areas as indicated on the Drawings and per this specification. Work shall include but is not be limited to:
 - 1. Drainage System Requirements
 - a. Gravel drainage trench fill material.
 - b. Panel drain pipe, collector pipe and fittings
 - c. Dynamic Stone Base and Finish Stone
 - d. Clean outs and inline structures/manholes Dynamic Stone Base and Finish Stone
 - e. Certified grade elevation survey of dynamic stone base installation
 - 2. Synthetic Turf Area Water System Requirements
 - a. Refer to Landscape Irrigation System
 - 3. Perimeter Anchor / Turf Edge Attachment
 - a. Refer to Cast-in-place concrete curbing and Drawings
 - 4. Synthetic Turf System Surfacing Installation
 - a. Refer to Synthetic Turf System Surface Specification

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section.
 - 1. 325250 Cast-in-Place Concrete Curbing
 - 2. 321813 Synthetic Turf System Surface

1.4 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern. Unless otherwise noted or specified, all work under this Section shall conform to the latest edition as applicable.
 - 1. Organizations and Governing Bodies
 - a. American Association of State Highway and Transportation Officials (AASHTO):
 - b. Occupational Safety and Health Administration (OSHA)
 - c. American Public Works Association (APWA) for Earthwork Requirements
 - d. American Society for Testing and Materials (ASTM):
 - e. Synthetic Turf Council (STC)
 - f. American Sports Builders Association (ASBA)
 - g. American Wood Preservers' Association (AWPA):
 - 1) C2 Lumber, Timbers, Bridge Ties and Mine Ties
 - 2) Preservation Treatment by Pressure Processes
 - 2. ASTM Standard Test Methods
 - a. F 405 Corrugated Polyethylene (PE) Tubing and Fittings
 - b. F 449 Subsurface Installation for Agricultural Drainage or Water Table Control
 - c. F 667 8, 10, 12 and 15-inch Corrugated Polyethylene Tubing and Fittings

1.5 DEFINITIONS

- A. Finish sub-grade: Final elevations and grading modifications to be performed by others and prior to the work in this specification section. Approved and certified finish sub-grade must be met prior to Synthetic Turf system surface installation.
- B. Gravel Drainage material: Stone material that may be used by others to achieve finish subgrade below the dynamic stone base. This material should bridge with the dynamic stone base as described herein.
- C. Dynamic Stone Base: Approved stone material with the sizing and performance characteristics described herein. This stone material is installed immediately on top of the finished subgrade surface.

- D. Topping Stone: Approved stone material with the sizing and performance characteristics described herein. This stone material is installed immediately on top of the dynamic stone base to create a smooth surface for the placement of the synthetic turf system as well as to aid in achieving finish grade tolerances of the synthetic turf area subsurface.
- E. Turf Base Contractor A specialty contractor who shall complete the preparation, construction and installation of the synthetic turf sub-drainage, turf anchor, dynamic base stone and finishing stone.
- F. Synthetic Turf Contractor The Company working for the Turf Vendor who shall oversee the turf surface installation for the synthetic turf areas.

1.6 SUBMITTALS

- A. Manufacturer's Product Data: Submit manufacturer's specifications, test reports and installation instructions for all products in this specification section, including certifications and other data as may be required to show compliance with the Contract Documents. Included but not limited to the following; drainage pipe material, panel drains, perimeter turf anchoring system.
- B. Material samples. Submit three samples each of the following:
 - 1. Panel drain product approximately 6 inches in length, full width
 - 2. Gravel Materials
 - a. 1-gallon samples of dynamic stone, topping stone, and gravel trench stone (if proposed).
 - b. See Section 1.7, "Quality Control"
 - c. Stone Base Source List / Approvals / Certifications
- C. Schedule
 - 1. Work schedule for all work described in this specification section. The Contractor shall update the schedule at a minimum of 2-week intervals thru substantial completion
- D. References / Successful Installations
 - 1. Certified list of successful existing installations, including Owner representative and telephone number, attesting compliance with quality assurance information.
- E. Quality assurance information
 - 1. Submit to Owner for approval as delineated in Quality Assurance below in this Specification section.
- F. Supplier List

Final Development Plans

- 1. Submit list of procured and contracted suppliers of all materials required for this part of the Work
- G. Qualifications Statements
 - 1. Submit experience requirements as described in the Quality Assurance portion of this specification.
- H. Turf Base Contractor Reference List (Refer to Quality Assurance)
- I. Turf Base Contractor Job Superintendent/Foreman Resume (Refer to Quality Assurance)
- J. Delivery Slips
 - 1. The Turf Base Contractor to submit all delivery slips during construction for stone materials to assure their previous approval prior to shipping and source location.
- K. Manufacturer's Review
 - 1. Submit written statement, signed by Base Contractor and synthetic turf surfacing installer/contractor stating that the Drawings and Specifications have been reviewed by qualified representatives of the materials manufacturer, and that they are in agreement that the materials and system to be used for synthetic turf surfacing are proper and adequate for the applications shown
- L. Site Acceptance Statements (Refer to Quality Assurance)
- M. Photographic Documentation
 - 1. Contractor to provide Owner and its representative's digital pictures of in progress work documenting work described in this Specification section

1.7 QUALITY ASSURANCE

- A. Experience
 - 1. The Turf Base Contractor performing the work in this specification section shall be a firm meeting the following criteria:
 - a. A minimum of ten (10) successful synthetic turf fields in the last three (3) years on projects comparable to this Scope of Work. Submit complete list of projects, including project description, date of completion, and contact information. Comparable projects shall minimally include but not be exclusive to the following Scope of Work;

- 1) Full field installations (75,000 sf or larger)
- 2) Laser grading (not GPS) experience for subgrade, gravel and finished surface meeting the requirements for finish grade elevations required in this Contract
- 3) Synthetic Turf field finish subgrade installation
- 4) Synthetic Turf Field drainage system installation
- 5) Synthetic Turf Field dynamic stone base installation and finished surface tolerances comparable to this project.
- 6) Experience with testing protocols for dynamic stone base and finish course.
- b. Firms must have been in business under the same Ownership for at least three years and shall have been installing similar sports fields for that entire period.
- 2. The resume of the Turf Base Contactor's superintendent/foreman who will be onsite during the installation shall be provided showing a list of (5) successful projects for which he/she was responsible.
- 3. The Contractor shall not replace the named individuals for the duration of the contract unless the substitute individuals have equivalent qualifications as approved by the Owner.
- 4. The Base Contractor shall be responsible for the protection of the finish stone surface thru its acceptance and when installation work begins on the synthetic turf surface.
- B. All piping and appurtenances shall be new, clean and in accordance with material specifications, unless specifically noted on the plans.
- C. Size and classification shall be shown on the plans or as specified herein.
- D. Site Acceptance Statements:
 - 1. Prior to Base Contractor beginning Work on subgrade of synthetic turf areas:
 - a. Submit a written statement signed by the Synthetic Turf Base Contractor noting that the site has been reviewed and that documents showing compaction and certified elevations/planarity by others have been reviewed on the subgrade. Note all discrepancies, conflicts or other issues. If none are found this should be noted in the statement. Upon acceptance, Work shall begin with the assurance that all work shall be warranted for the period as specified in these Documents.
 - 2. Prior to Turf Contractor beginning work on Base installation:
 - a. Inspection and Acceptance: The Turf Base Contractor and the Synthetic Turf Contractor shall inspect the subgrade and drainage system to verify their

acceptance of installation and condition and shall confirm acceptance in writing. Commencement of subsequent installation in a given work area indicates acceptance of underlying substrates and systems.

- 1) The Base Contractor shall remain on site for the initial layout of the turf product by the Turf Contractor to verify that the work of the Base Contractor is not being damaged or altered in a way that would jeopardize conformance to the documents.
- 2) The intent and requirements of this Contract is that these two entities shall agree that base work prior to installation of the synthetic turf and just after installation of the turf conforms to the documents and to the standards of the Turf Manufacturer so that Warranty/Guarantee will be honored in full force by both parties.
- E. Grade Certifications: A certified survey by a State Licensed land surveyor shall be made at the top of the Finish Subgrade and at the top of the installed Dynamic Stone/Finishing Stone base to verify conformance to specified final elevations. GPS survey laser equipment shall not be used for any finish elevation determination. Equipment mounted laser and hub or similar are required for turf area grading operations. Survey shall include spots at a 25-foot grid for entire turf area and shall show tenth foot contours. Survey shall be set up so that spots begin from the exact center of the turf area and symmetrical in both directions. Spots shall include the extent/outer edge of the stone base work and the perimeter curb/turf anchor.
- 1.8 QUALITY CONTROL
 - A. Pre-bid: Materials Inspection and Testing:
 - 1. Bidders are encouraged to:
 - a. Pre-test gravel drainage materials with an independent Testing Agent prior to submitting a bid. This does not guarantee that the materials or source will be approved for construction.
 - b. Pre-qualify any material deviating from that specified.
 - c. All costs associated with pre-bid testing shall be borne by the bidder.
 - B. After Bid Award and Prior to construction: Submit samples of each of the following materials to establish Baseline specification and ratios for the remainder of the testing process.
 - 1. Gravel Drainage Material: Provide a one-gallon sample of each gravel drainage source and for each type of gravel material to be used for testing. This could include:
 - a. Dynamic Base Stone
 - b. Topping Stone

- C. During Construction: Submit samples of each of the following during mass production of gravel materials for performance testing and prior to shipping.
 - 1. Gravel Drainage/Dynamic Stone/Topping Stone Material:
 - a. A minimum of one-gallon sample for every 500 cubic yards of each material used shall be tested by the Testing Agent for general compliance with the established Baseline specifications.
- D. Testing Agent
 - a. The Contractor shall hire a testing agent to certify and make recommendations regarding synthetic turf system materials. Turf Base Contractor shall notify the Owner/Construction Manager regarding timing, scheduling and use of these agents.
 - b. Agent shall be independent, A2LA accredited, USGA recommended and insured.
 - c. The Testing Agent shall perform testing of the turf system material components, including but not limited to dynamic stone and topping stone as well as to certify the capability of the dynamic stone base course to meet permeability and stability requirements before construction.
 - d. The Testing Agent is to report/submit test results as they are known and simultaneously to the Turf Base Contractor, the Owner and its representatives.
 - e. Potential Agents for Owner Consideration (A2LA Accredited, USGA Recommended)
 - 1) Turf and Soil Diagnostics, Sam Ferro, (913) 723-3700
 - Tifton Physical Soil Testing Laboratories, T. Powell Gaines, (229) 382-7292
 - 3) Thomas Turf Services, James Thomas, (979) 774-1600
 - f. The Engineer shall recommend for owner approval or rejection based on results of the tests and recommendation of the Testing Agent.
 - 2. The Contractor is required to use a licensed Land Surveyor registered in the State for all layout and engineering work.

1.9 DELIVERY, STORAGE AND HANDLING

- A. All materials shall be delivered and stored within the Contractor's work limits or in an area approved by the Owner.
- B. All material shall be stored in strict accordance with the manufacturer's recommendations.

- C. Special care shall be exercised during delivery and storage to avoid damage to the products.
- D. Products that are damaged will be removed and replaced, unless the product can be repaired in an acceptable manner by the Contractor, at his expense.
- E. Packaged Materials:
 - 1. Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site. Store out of low lying or drainage areas.
- F. Drainage Gravel and Dynamic Stone Base:
 - 1. Deliver tested and approved lots in clean, washed and covered trucks to eliminate contamination during transportation. Place directly on synthetic turf area. Do not stockpile on site.
- 1.10 PROJECT CONDITIONS
 - A. Do not store drainage system materials or components over wet, frozen, or muddy base.
- 1.11 BASE WORK COMPLETION PRIOR TO COMMENCEMENT OF SYNTHETIC TURF SURFACE
 - A. Refer to 321813 Synthetic Turf System Surface Specification for Final Submittal and Acceptance Requirements regarding Preliminary and Substantial Completion for the Synthetic Turf areas.
 - 1. Turf Base Contractor to Review these Final Acceptance requirements and submit all pertinent items concurrently with the Turf Installer / Turf Manufacturer as one joint submittal to the Owner and its Representatives.
 - B. Base work Completion: The following items are to be complete and operational prior to the installation of the Synthetic Turf and infill. These items will have been systematically observed and approved by the Owner and or its representatives as they are completed in the construction sequence of the Base work. To be considered "Complete" and ready for Turf installation, the following items shall be provided and achieved:
 - 1. Drainage system installed and operational
 - 2. Dynamic stone base in place, compacted and to certified grade elevations
 - 3. Watering system installed and operational. Ground boxes set to finish grade (Refer to and coordinate with Landscape Irrigation documents/Contractor)
 - 4. Perimeter anchor installed and approved

1.12 WARRANTY/GUARANTEE – SYNTHETIC TURF SUBSURFACE DRAINAGE SYSTEM

- A. General: Warranties / Guarantees specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and are in addition to and run concurrent with other warranties/guarantees made by the Contractor under requirements of the Contract Documents.
- B. The following are inclusive of the term "Synthetic Turf System" for provisions of the guarantee:
 - 1. Final grade tolerances to one-quarter inch in the length of 25' of finish grade in any direction.
 - 2. Working functions of the drainage system.
 - 3. All materials and products specified.
 - 4. Water system included with Landscape Irrigation warranty
- C. Synthetic Turf System Installer Guarantee: The President/Principal(s) of both the Synthetic Turf Contractor and the Turf Base Contractor (if different) shall sign this document and it shall include the following:
 - 1. Guarantee shall include removal and replacement of materials (parts and labor) listed in this specification not performing to the standards described to repair synthetic turf system at no cost to the Owner.
- D. Contractor shall not be held liable for incidental or consequential damages.
- E. The Warranty does not cover any defect, failure, damage caused by or connected with abuse, neglect, deliberate acts, acts of God, casualty or loads exceeding the Contractor's recommendations.

PART 2 - PRODUCTS

2.1 SYNTHETIC TURF AREA SUBDRAINAGE SYSTEM MATERIALS

- A. Underdrain Collector Pipe and Fittings
 - 1. General
 - a. Review drawings for locations of perforated and non-perforated piping.
 - b. Solid wall pipe shall be high-density polyethylene pipe (HDPE) and shall conform to the requirements of AASHTO M252 Type S for 4 to 10-inch diameters and AASHTO M294 or ASTM F2306 Type S for 12 to 60-inch diameters.
 - c. Perforated pipe shall be double wall high-density polyethylene pipe (HDPE) and shall conform to the requirements of AASHTO M252 Type SP for 4-inch

to 10-inch diameters and AASHTO M294, Type SP or ASTM F2306 for 12 inch to 60 inch diameters.

- d. HDPE Perforated pipe shall have Class 2 slotted perforations in accordance with AASHTO M252 and M294.
- e. Virgin material for pipe and fitting production shall be high-density polyethylene conforming to the minimum requirements of cell classification 424420C for 4-inch to 10-inch diameters, and 435400C for 12-inch to 60-inch diameters, as defined and described in the latest version of ASTM D3350, except that carbon black content should not exceed 5%.
- f. Provide drainage pipe complete with bends, reducers, adapters, couplings, collars, and joint materials.
- g. Solid wall pipe joints and fittings shall meet the watertight joint performance requirements of AASHTO M252, AASHTO M294, or ASTM F2306. 4-inch through 60-inch shall be watertight according to the requirements of ASTM D3212. Gaskets shall be made of polyisoprene meeting the requirements of ASTM F477. Gaskets shall be installed by the pipe manufacturer and covered with a removable, protective wrap to ensure the gasket is free from debris. A joint lubricant available from the manufacturer shall be used on the gasket and bell during assembly.
- h. Solid wall HDPE 12-inch through 60-inch diameters shall have a reinforced bell with a bell tolerance device. The bell tolerance device shall be installed by the manufacturer.
- i. Provided drainage pipe complete with all fittings such as bends, reducers, adapters, couplings, collars, and joint materials. Fittings and couplers for perforated HDPE pipe shall be split couplings or snap couplings manufactured by the same manufacturer as the corrugated HDPE.
- j. Manufacturer's certification according to AASHTO M252 and M294 shall be submitted to the Engineer prior to installation of the pipe.
- 2. Products
 - a. Advanced Drainage Systems (ADS)
 - b. Approved Equivalent
- B. Underdrain Panel Drains and Fittings
 - 1. General
 - a. Corrugated panel drain shall conform to the requirements for Class B Geocomposite as defined in ASTM D7001-06. This geocomposite product shall be composed of a flat pipe design consisting of a full circumference polyethylene core.
 - b. All materials and fittings shall conform to ASTM D7001-06.
 - c. The corrugated panel drain shall have a nominal thickness of 1-inch and a nominal width of 12-inch.
 - d. The core shall have a minimum compressive strength of 7,500 psf.
 - e. Geotextile wrap shall not be used on panel drain.

- f. Provided panel drain complete with all fittings such as bends, reducers, adapters, couplings, collars, and joint materials. All fittings shall be supplied by the same manufacturer as the panel drain.
- 2. Products
 - a. Hydraway Drain 2000
 - b. Approved Equivalent
- C. Clean Out: Provide clean out fittings fabricated from ASHTO-M252 polyethylene pipe that includes threaded polyethylene cap.
- D. Collector Pipe Inline Drainage Structures / clean outs and sized as per drawings:
 - 1. General
 - a. Inline structures only are to be used. Risers with fittings are not allowed.
 - 2. Products:
 - a. Cleanouts
 - 1) Nyloplast Drain Basin
 - 2) Nyloplast Inline Drain
 - b. Grate
 - 1) Solid, Ductile Iron
 - 3. Suppliers
 - a. Nyloplast-ADS
 - 1) www.ads-pipe.com/us
 - b. National Diversified Sales
 - 1) www.ndspro.com
 - c. Approved Equivalent.
- E. Dynamic Stone Base and Top-Dressing Stone
 - 1. The dynamic stone base shall conform to the turf vendor's standard specifications subject to the Engineer's approval and meet the following requirements using ASTM Method C136:
 - 2. All stone shall be angular. Rounded or river stone is not acceptable. Material shall be hard, durable, washed stone free of deleterious materials.

- 3. In no instance shall multiple quarry sources be used for the project.
- 4. Top dressing stone shall bridge with selected dynamic base stone to prevent loss of top stone into base. Dynamic base shall also bridge with stone material used by others to achieve subgrade.
- 5. Bridging Characteristics:
 - a. D85 Top Stone x 5 > D15 Base Stone
 - b. D85 Top Stone / D15 Base Stone <2
- 6. Drainage Characteristics
 - a. Permeability for base stone shall be greater than 50"/hr.
 - b. Permeability for top dressing stone shall be greater than 30"/hr.
 - c. Porosity for top dressing and base stone shall be greater than 25% when compacted and saturated.
- 7. Top dressing Stone is allowed for use to level the finished surface of the base stone. Total allowable depth to be in the range of 1/2 to 3/4 inch after installation and finish grade.
- 8. The dynamic base gravel should meet one or both of the following stability requirements:
 - a. Sulfate Soundness (C-88) (Required)
 - 1) Not to exceed 12% loss
 - 2) This is a long lead item for testing. Contractor shall submit and gain approval to maintain project schedule.
 - b. LA Abrasion (ASTM C131) (Desired, Optional)
 - 1) Not to exceed 40

2.2 SYNTHETIC TURF PERIMETER ANCHOR / TURF EDGE ATTACHMENT

- A. Turf Attachment Methods: The Turf shall be attached at the perimeter as follows:
 - 1. Cast in Place Concrete Curb / Wood Nailer Combination
 - a. Wood nailer is attached to the turf area side of the Concrete curb with the top of the wood nailer being recessed below the top of the curb. Turf shall be attached to the wood nailer.
 - b. Top of wood Nailer shall be no greater than ³/₄ 1 inch below curb so that when infill material is placed the infill and top of curb are flush/no tripping will occur in elevation.
 - c. Wood Nailer Board
- 1) YellaWood 2" x 4"
- 2) Approved equivalent
- d. Anchor Nails
 - 1) Stainless Steel Ramset/RedHead
 - a) Use 4 nails per 8-foot length nailer
 - b) Use 5 nails per 10-foot length nailer
 - c) 4 inches from end of board
 - 2) Approved equivalent
- 2. Cast in Place Concrete curb with formed notch
 - a. This method may be used at the recommendation of Turf Contractor.

2.3 SYNTHETIC TURF AREA WATER SYSTEM MATERIALS

A. General: Refer to Landscape Irrigation documents.

PART 3 - EXECUTION

- 3.1 EXAMINATION AND PROTECTION
 - A. Verification of Conditions: Examine areas and conditions under which all work of this Section is being performed. Commencement of work implies acceptance of all areas and conditions.
 - B. Contractor to Protect and use care in regard to adjacent construction and other surrounding work.
 - C. Protection of Work this Contract: Protect all on-going work, so as not to delay work due to weather or project related construction. This includes but is not limited to the use of tarps, geotextile, plywood and other protective measures.
 - D. Protection of Persons and Property: Provide all necessary measures to protect workmen and passersby.

3.2 SYNTHETIC TURF AREA SUBGRADE ACCEPTANCE

- A. Synthetic Turf Area Subgrade by others prior to the commencement of this specification section.
- B. Tolerances and Certifications

- 1. The following will be required for the Contractor performing subgrade work and should be the expected result by the Turf Base Contractor prior to beginning Finish grade.
 - a. Subgrade Tolerance Requirements: The final elevation of the subgrade is plus or minus one inch at any point on the turf area and on a 25-foot grid as indicated on the Contract Drawings.
 - b. Subgrade Elevation Certification: A certified survey by a State licensed land surveyor with elevations noted on a 25-foot grid to verify required grade and elevation tolerances of the subgrade. The digital survey document indicates spot elevations and tenth of foot contours and was submitted to the Engineer/Owner for review and approval prior to moving to next part of work.
 - c. Subgrade mirrors the final finish elevation of the turf area surface in regard to slope except where noted on the drawings.
 - d. Documents showing compaction meets 95% Standard Proctor
- C. Commencement of work in this specification section implies acceptance of the subgrade conditions.
- 3.3 SYNTHETIC TURF AREA PERIMETER ANCHOR / TURF EDGE ATTACHMENT
 - A. Install/form notch at turf edge of curb or install wood nailer to concrete curbing at entire perimeter/edges of turf installation
 - B. Coordinate installation with installation of other adjacent construction as shown on the drawings
- 3.4 SYNTHETIC TURF AREA WATER SYSTEM / CONDUIT INSTALLATION
 - A. General: Coordinate installation of turf drainage base and finish subgrade with irrigation lines installed as part of the landscape irrigation system.
- 3.5 DRAINAGE SYSTEM INSTALLATION
 - A. Collector Pipe Trenching:
 - 1. Contractor to connect synthetic turf drainage system to site storm drainage system and as coordinated with the General Contractor.
 - 2. Excavate trenches for all piping to a uniform depth and width, sufficiently wide enough to provide ample working room and into the previously installed subgrade material.
 - a. Minimum width of trench to be twice the pipe diameter.

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- 3. Excavate trenches to depth indicated or required to establish indicated slope and invert elevations and to support bottom of pipe
- 4. Contractor to remove or manipulate spoils from trenching excavation so that integrity of finished grade requirements is maintained
- B. Panel Drain Pipe Trenching
 - 1. Only perform trenching, drainage pipe installation and backfilling operations that can be completed in one day
 - 2. Panel trenching to be at a depth so that top of panel is flush with finish subgrade and at a width to comfortably place and install panel.
- C. Installation of Collector piping:
 - 1. Lay perforated pipe directly on trench bottom in accordance with pipe manufacturer's recommendations.
 - 2. Provide collars and couplings as required for installation of these lines as well as for connections to drainage structures
 - 3. Install collector as indicated on drawings so that it connects to site structures
 - a. Protect any exposed ends of pipe until connected to detention or storm sewer system by Synthetic Turf Contractor or others
 - 4. Pipe laying work shall commence at the main collector line and shall proceed from low point of system to high point.
 - a. Pipe shall be laid true to line and grade in such a manner as to assure a close concentric joint with the adjoining pipe.
 - b. Protect any exposed ends of the pipe until final connections are made.
 - c. After pipe installation has been observed by the Engineer, drainage material shall be placed around and over the pipe.
 - 5. Install inline structures, drain inlets, catch basins per manufacturer's instructions
 - 6. After pipe installation has been observed by the Landscape Architect/Engineer, approved drainage material shall be placed around and over the pipe to the top of the trench.
 - a. If observation indicates poor alignment, debris, displaced pipe, infiltration or other defects, Contractor to take whatever steps are necessary to correct such defects prior to proceeding
 - 7. Installation of drain lines from in ground accessories
 - a. Install drain lines from in ground boxes installed in the field area. Connect directly to field drainage system

- 8. Collector pipe Clean Out: A nyloplast or equal structure is to be used for the cleanout. Cap shall be placed flush with finish subgrade as shown on the drawings. Install bolt, washer and nut on cap for metal detection purposes
- D. Installation of Panel Drains:
 - 1. Install panel drains per the manufacturer's written instruction.
 - 2. The panel drains are to be installed in shallow trenches minimally equal to the height and 1.5 times the width of the panel drains and directly over the top of the geotextile fabric.
 - 3. Connect panel drains to collector/header piping using panel drain manufacturer provided fittings, per manufacturer instructions and as shown on drawings.
 - 4. Provide 48 hours' notice to the Engineer to inspect the panel drains in place prior to covering.
- E. Installation of drain lines from in ground boxes
 - 1. Install drain lines from in ground boxes in the turf area. Connect directly to turf area drainage system or minimally to the gravel perimeter trench.
- F. Clean Out/End Cap: Cap shall be recessed below the dynamic stone and flush with finish subgrade elevation. Install bolt, washer and nut on cap for metal detection purposes

3.6 INSTALLATION OF DYNAMIC STONE BASE/TOPPING STONE

- A. Install only tested and approved material at a uniform depth.
- B. Placement of the dynamic stone base shall proceed from a stable area next to the geotextile fabric and systematically worked outward onto the area.
 - 1. Laser operated equipment, string lines or screed boards shall be utilized.
 - 2. All equipment used in spreading or traveling on the cover layer shall exert low ground pressures and shall be approved by the manufacturer and Engineer.
 - 3. During placement and spreading,
 - a. A minimum depth of 6 inches of granular material shall be maintained at all times between the fabric and wheels of trucks or spreading equipment.
 - b. All equipment traveling on the cover layer shall avoid making sharp turns, quick stops or quick starts.
 - c. Care shall be taken to not disturb, displace or damage the drainage system.
 - d. Contractor shall install dynamic stone layer in such a way as to reduce separation of the fines and larger particles in the stone blend.
- C. Placement of the Topping Stone: This stone layer shall be placed over the dynamic stone base at a finished depth as shown on the drawings to produce a level/smooth surface prior to the placement of the synthetic turf. Due to possible drifting of this finish stone material into the dynamic stone layer below, more material may be required than the

finished depth to eventually achieve finished grade elevations at the top of the finish stone layer and shall be considered as part of the overall quantities necessary.

- 1. Contractor shall install topping stone layer in such a way as to reduce separation of the fines and larger particles in the stone blend.
- D. Finish grade for Dynamic Stone Base and Top-Dressing Stone
 - 1. Shall be verified using laser operated survey instrument with a tolerance of +/- onequarter inch over 25 feet in any direction.
- E. Stone base elevation verification: A survey of the finished elevation for the stone base is to be developed by a State licensed surveyor over the entire surface in a 25-foot grid. The survey shall be certified (signed) and submitted to the Owner and its representatives for approval prior to installing the synthetic turf. The survey shall indicate spot elevations and tenth of foot contours starting from the exact center point of the field, working in both directions and including the field curb and outer extent of the field system perimeter limits.

3.7 INSTALLATION OF SYNTHETIC TURF

A. Refer to 321813 - Synthetic Turf Surface System Specification. To commence only after acceptance of Base Work performed in this Specification Section.

3.8 CLEAN UP

- A. At the end of each day, remove all scraps and other debris created by the synthetic turf installation from the area.
- B. At end of synthetic turf installation and just prior to punch list, contractor to use magnetic device/equipment to remove all metallic materials on turf or adjacent area caused by turf construction.
- C. Remove all surplus excavated material not required for filling and backfilling, trash, and debris and dispose of it properly off of the Owner's property at Contractor's expense.
- D. Leave the premises and work in clean, satisfactory condition.
- E. Ground boxes (if applicable) to be cleaned of debris and if necessary clean gravel added

3.9 FINAL SUBMITALS

A. Refer to Completion and Final Acceptance in Synthetic Turf Surface System Specification Section.

Final Development Plans

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- B. Final Spot Elevation Certification documents for all synthetic turf areas.
- C. Warranty/Guarantee Documents as described in this Specification Section.

3.10 PROTECTION

A. Protection of materials and work shall be the responsibility of the Contractor during installation and thru acceptance/substantial completion. All material damaged prior to acceptance shall be replaced at no cost to the Owner.

END OF SECTION 321823

SECTION 323300 - 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. Removable bollard.
 - 2. Planter.
 - 3. Infill Floordoor.
 - 4. Custom wood slat bench

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.
- B. Warranties.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Manufacturer regulary engaged in manufacture of site furnishings for 10 years.
- B. Product Support: Products are supported with complete engineering drawings and design patents.
- C. Production: Orders are filled within a 40-day schedule.
- D. Facility Operator: Welders and machine operators are certified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Storage: Store materials in clean, dry area in accordance with manufacturer's instructions. Keep materials in manufacturer's original, unopened containers and packaging until installation.
- C. Handling: Protect materials and finish during handling and installation to prevent damage.

PART 2 - PRODUCTS

- 2.1 MATERIALS
 - A. As shown on the plans.
 - B. Per manufacturer's recommendations and specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Notify Landscape Architect of conditions that would adversely affect installation or subsequent use.

3.2 INSTALLATION

- A. Do note begin installation until unacceptable conditions are corrected.
- B. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- C. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

D. Install site furnishings level, plumb, true, and positioned at locations indicated on Drawings.

3.3 ADJUSTING

- A. Finish Damage: Repair minor damage to finish in accordance with manufacturer's instructions and as approved by Landscape Architect.
- B. Component Damage: Remove and replace damaged components that cannot be successfully repaired as determined by Landscape Architect.

3.4 CLEANING

- A. Clean furnishings promptly after installation in accordance with manufacturer's instructions.
- B. Do not use harsh cleaning materials or methods that could damage finish.

3.5 PROTECTION

A. Protect installed furnishings to ensure that, except for normal weathering, furnishings will be without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 328400 - PLANTING IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes furnishing all labor, materials, accessories and equipment, and performing all operations necessary for the complete installation of the landscape irrigation system, permits and including items listed below:
 - 1. Piping.
 - 2. Manual valves.
 - 3. Automatic control valves.
 - 4. Automatic drain valves.
 - 5. Spray and rotor heads.
 - 6. Driplines
 - 7. Quick couplers.
 - 8. Controller.
 - 9. Boxes for automatic control valves.
- B. Irrigation Control System
 - 1. The construction includes one (1) satellite controller as shown on the irrigation plans.
 - 2. Power shall be provided to the irrigation controller by electrical contractor. Final connection by irrigation contractor.
- C. All bids should reflect a total "turn-key" installation for the site. This would include all equipment necessary to install satellite controller, including necessary wiring, communications equipment, electrical service, water supply and lines needed to communicate with the irrigation control system. Each bid shall include all equipment and labor necessary to provide a "turn-key" installation.
- D. Each proposal shall include the cost to install a combination flow meter and master valve as indicated on the design drawings. This meter and valve shall be connected just past the water meter connection at each site. This meter and valve shall be capable of relaying this information to the central irrigation control system point computer to provide flow information of each valve as it waters. It shall also be capable of detecting any flow that is occurring when no valves are operating, such as a broken main line would create. This flow sensor should then be capable of sending a signal to the central irrigation control system that will then in turn close the master valve. The bid for each flow meter and valve shall include the meter/valve and any other items needed for a "turn-key" installation. The bid price for this meter and valve shall be shown as a separate bid item for this site.
- E. The contractor shall include a projected time frame for installing the system. It should reflect, in calendar days, the anticipated time required from the day of the award to completion of the system in a fully operational mode. This schedule should reflect

anticipated time for ordering and receiving all components, starting and ending times for installation, starting and ending times for training, system start-up, etc.

1.2 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be central control system with automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.
- C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
 - 1. Irrigation Main Piping: 120 psi
 - 2. Circuit Piping: 60psi

1.3 SEQUENCING/SCHEDULING

- A. Obtain information pertaining to the location of all existing utility lines and equipment prior to irrigation installation.
- B. Install sleeves for all mainline, laterals, and wire that cross roadways, drives, sidewalks, and all other paving surfaces prior to placement of paving. It is the responsibility of the Irrigation Contractor to coordinate timing of sleeve installation and construction procedure with Paving Contractor to ensure proper sequencing.
- C. Give at least seven (7) days notice to the Landscape Architect or his representative prior to all required site visits as indicated herein.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories. Only materials and items of equipment so approved shall be used.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Approvals: Submit documentation of all approvals required by local, municipal, and state jurisdictions.
- D. Grounding and Line Surge Protection Verification: The Irrigation Contractor is to provide written documentation and verification that each grounding device meets the manufacturer's specified requirements for grounding and line surge protection. The tests shall be completed using an approved ground resistance tester. The Rain Bird ASP shall conduct testing.

1.5 INFORMATIONAL SUBMITTALS

- A. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operational and Maintenance Data: Submit manufacturer's data in a three-ring binder, labeled and indexed
- B. Record Drawings: Irrigation Contractor shall record and submit an "As-Built Drawing" which records actual installed conditions. The As-Built Drawing shall be submitted in an electronic format. Irrigation Contractor shall submit the As-Built Drawing to the Landscape Architect before work under this contract will be considered for Acceptance.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Manufacturing Qualifications: Provide landscape irrigation system as a complete unit produced by acceptable manufacturers for all portions of work, including heads, valves, piping, controllers, and accessories.
- C. Installer qualification: Contractor shall be a firm specializing in irrigation work with a minimum of 10 years' experience in work of this type. The irrigation contractor shall provide written proof of attendance at a manufacture's supported training program regarding the installation, programming and trouble-shooting for a Rain Bird IQ v4.0 decoder based irrigation control system. These qualifications must be present prior to any work beginning on this project.
- D. Authorized Service Provider requirements: Contractor shall have Authorized Service Provider (ASP) provide commissioning of irrigation control system including verification of specified Rain Bird Components, Correct wire and connectors, Grounding of required components, and proper start-up and initial programming.
 - 1. Approved Rain Bird Authorized Service Provider/Central Control Service Provider
 - a. Irrigation Management Company (IMC) 816-215-1810
- E. Referenced Standards: American Society for Testing and Materials, Annual Book of ASTM Standards, latest edition.
- F. Codes and Standards: Irrigation installation shall comply with all applicable federal, state and local governing agency requirements and to industry standards. Notify Landscape Architect immediately in writing of any discrepancies, inconsistencies, or contradictory requirements.

- G. Workmanship: Install materials and equipment in a neat and professional manner following manufacturer's recommendations.
- 1.8 FEES AND PERMITS
 - A. Work under this Section shall include all fees, permits, licenses, and required inspections by concerned governing agencies.
- 1.9 DELIVERY, STORAGE AND HANDLING
 - A. Deliver materials and equipment in such a manner as not to damage the parts or decrease the useful life of equipment.
 - B. Store materials away from detrimental elements. Coordinate with Owner's Representative, General Contractor, or Landscape Contractor, as appropriate, to secure a safe staging area.
 - C. Handle, load, unload, stack, and transport materials carefully to avoid damage. Handle pipe in accordance with manufacturer's recommendations.
- 1.10 JOB CONDITIONS
 - A. Prior to commencing any work required under the Contract, the Contractor shall locate all utilities, subsurface drainage, and underground construction so that proper precautions may be taken not to disturb or damage any subsurface improvements. Damage to any of the above mentioned items or other shall be promptly repaired by the contractor at no additional cost to the owner.
 - B. Water service and electric service will be supplied by the General Contractor as indicated on the plans for the purpose of the automatic irrigation system.
 - C. Irrigation System is to operate under the water pressure and flow rates prevailing at the project site. Irrigation Contractor shall be responsible for determining these parameters, and shall design the irrigation system in accordance with the existing or anticipated conditions.
 - D. Insurance on irrigation materials or equipment stored or installed is the responsibility of the Irrigation Contractor. Such insurance shall cover fire, theft, and vandalism. Should the Irrigation Contractor elect not to provide such insurance the Owner shall in no way be responsible for any losses incurred by the aforementioned acts. The Irrigation Contractor is responsible for all costs incurred in replacing damaged or stolen materials or equipment prior to Substantial Completion of the Work.
 - E. Obtain all required permits and pay all required fees at no additional cost to the Owner. Any penalties imposed due to failure to obtain permits or pay fees are the responsibility of the Irrigation Contractor.
 - F. Provide and maintain all passageways, guard fences, warning lights, and other protection devices required by local authorities or others having jurisdiction.

- G. Irrigation Contractor shall adequately protect adjacent property as provided by law and the Contract Documents.
- H. Existing Site Improvements: Perform Work in a manner that avoids damage to existing site improvements. The Irrigation Contractor is responsible for any damage of mechanical nature as well as damage resulting from leaks in the irrigation system whether due to negligence or otherwise.
- I. Test water conditions: Irrigation System is to operate under the water pressure and flow indicated on the irrigation plan. It shall be the responsibility of the Irrigation Contractor to measure or analyze the existing or anticipated water supply at the tap. Notify the Landscape Architect if conditions vary from plans.

1.11 WARRANTY AND SUBSTANTIAL COMPLETION

- A. Substantial Completion
 - 1. At the completion of the installation of the irrigation system components, and at the direction of the Owner, the Landscape Architect shall observe the conditions of the project for the purpose of verifying compliance with plans, details and specifications. A written report will be provided to the Owner listing any deviations or omissions. These issues will be resolved and verified by the Landscape Architect prior to the issuance of a Letter of Substantial Completion.
 - 2. Contractor shall provide Landscape Architect with written notification from Rain Bird ASP stating that all installation, testing and training of the Central Control System has been completed and approved. Notification shall be received prior to substantial completion.
- B. All irrigation equipment including irrigation controller, control valves, sprinklers, rotors, and accessories shall have a five (5) year manufacturer's warranty. All other irrigation equipment, workmanship, and, supplies shall be warranted for one (1) year from date of issuance of the letter of substantial completion. All warranties shall be turned over to the Owner.

1.12 TRAINING

- A. A minimum of 2 hours of training, as determined by Rain Bird, for up to two (2) users determined by Owner and Landscape Architect shall be conducted by the ASP on site, with installed system, after completion of project. The contractor is to schedule, coordinate, and attend the training session. Training shall include an overview of system operations as well as detailed one-on-one training for selected individuals for both software and hardware operation.
- B. The control system manufacturer is to provide toll-free phone-in support to the Owner at no cost for a period of one (1) year within the initial purchase price of the system.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Specific requirements concerning the various materials and the arrangements in which they are to be installed are outlined in this Specification.
- B. Quality and Size
 - 1. Material specified by name and / or model number in the Specifications, on the site, or detailed drawings are used for the purpose of identification of materials and to ensure specific use of that material in the construction of the system. No substitutions will be permitted without approval.
 - 2. All materials used in the system must be new and without flaws or defects of any type and be the best quality available.

2.2 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Contractor materials shall comply with all requirements and provide irrigation equipment products from only the following:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products not listed within this section may be incorporated into the Work.
 - 2. Irrigation equipment including spray heads, rotors, nozzles, control valves, quick couplers, master valves, irrigation controller, rain sensors, low volume irrigation equipment, drip tubing and drip fittings including pressure regulators, filters, air relief valves, tree root watering devices, pipe fittings including swing assemblies, swing joints, barbed fittings, swing pipe and compression fittings shall be manufactured by the Rain Bird Corporation.
 - a. Or approved equal
 - 3. Decoder based irrigation control system equipment including, field decoders, line surge protection devices, sensors decoder and field transmitters shall be manufactured by the Rain Bird Corporation.
 - a. Or approved equal
 - Decoder control wire shall be manufactured by Rain Bird Corporation.
 a. Or approved equal
 - 5. Wire connectors shall be manufactured by 3M Corporation.
 - a. Or approved equal

2.3 DELIVERY, STORAGE AND HANDLING

- A. Manufactured materials shall be delivered in original containers with brand and maker's names marked thereon. Materials in broken containers or showing evidence of damage will be rejected and must be immediately removed from the work.
- B. Store plastic pipe on flat pallets and protect from sunlight.

2.4 PIPES, TUBES, AND FITTINGS

- A. Main Irrigation supply line for potable water. PVC plastic pipe, ASTM D 2241 Class 200 SDR 21.
 - 1. All PVC pipe from sizes three (3) inches and above shall, unplasticized rigid polyvinylchloride (PVC) pipe with integral bell and rubber ring gasket unless otherwise specified.
 - 2. All PVC pipe from sizes two and one half (2 1/2) to one (1) inch shall be Class 200, solvent weld PVC pipe.
 - 3. All pipe shall be supplied in standard twenty (20) foot lengths.
 - 4. Polyethylene pipe will not be accepted unless prior written approval is obtained by the landscape architect.
- B. Circuit Pipe for potable water (downstream from circuit valves): PVC plastic pipe, ASTM D 2241 Class 200 SDR 21.
 - 1. All PVC pipe from sizes three (3) inches and above shall, unplasticized rigid polyvinylchloride (PVC) pipe with integral bell and rubber ring gasket unless otherwise specified.
 - 2. All PVC pipe from sizes two and one half (2 1/2) to one (1) inch shall be Class 200, solvent weld PVC pipe.
 - 3. All pipe shall be supplied in standard twenty (20) foot lengths.
 - 4. Polyethylene pipe will not be accepted unless prior written approval is obtained by the landscape architect.
- C. All pipe that is exposed or not below grade shall be Schedule 80 PVC or HDPE.Seamless Copper Pipe: ASTM B88, Type M, drawn temper.
- D. Sleeving Pipe for Potable Water Irrigation Supply Line: PVC plastic pipe, Schedule 40, ASTM D 1785 and D 1784, PS 21-70.
- E. Fittings:
 - 1. For PVC plastic pipe,
 - a. All pipe fittings size four (4) inches and greater shall be ductile iron.
 - b. 3" fittings shall be bell and rubber gasket.
 - c. Fittings 2-1/2" and under shall be Schedule 40 solvent weld PVC. ASTM D 2466 socket fittings with ASTM A 2564 solvent cement.
 - 2. Metallic: Cast bronze with standard iron pipe thread; 125 bl. class rating in conformance with ANSI B16.15.
 - 3. Copper: ANSI B16.22 wrought copper or cast brass, recessed solder joint type fittings.
- F. Nipples:
 - 1. Metallic: Schedule 40 red brass (35% copper, 15% zinc) pipe: threaded both ends. Pipe shall be in accordance with ASTM B43.

- 2. Plastic: Factory-threaded Schedule 80, Type 1, Grade 1 polyvinyl chloride (PVC) pipe, threaded both ends. Pipe shall be in conformance with ASTM D1784 and D1785. Color: grey.
- G. Pipe Connection Materials: Solvent, primer and lubricants as recommended by the manufacturer.
 - 1. Joint compound for threaded connections is Teflon or approved equal tape; UL listed.
 - 2. No thinning of solvent or primer is allowed in any manner whatsoever.

2.5 WATER METER

A. Water meter shall be sized as needed, and shall be provided per City specifications.

2.6 BACKFLOW PREVENTER

A. Back Backflow preventer shall be of the type required by the local water supplier and local codes. Backflow preventer shall be sized to meet flow and pressure requirements of the plans.

2.7 IRRIGATION CONTROL SYSTEM SLEEVING

- A. Install separate sleeve beneath paved areas to route each run of wiring. Any existing sleeving is not to be used without the consent of the owner's representative.
- B. Sleeving material beneath pedestrian pavements shall be PVC Class 200 pipe with solvent welded joints.
- C. Sleeving beneath drives and streets shall be PVC Schedule 40 pipe with solvent welded joints.
- D. Sleeving diameter shall be equal to twice the diameter of the wiring bundle.

2.8 VALVES

- A. Manufacturer's Standard, of type and size required, and as follows:
- B. Furnish valves with plastic bodies, glass filled nylon or red brass, unless otherwise indicated.
- C. Pressure Reducing Valve: If required, standard capacity water pressure reducing valve with integral strainer, Watts U5 series or equal.
- D. Master Valve.
 - 1. Globe valve shall be normally closed 24 VAC 50/60 cycle solenoid actuated with a pressure rating of not less than 200 psi.

- 2. The valve body and bonnet shall be constructed of heavy cast red brass; diaphragm shall be of nylon reinforced nitrile rubber. All other internal parts shall be made of bronze, brass and stainless steel.
- 3. The valve shall have both internal and external manual open/close control to manual open and close the valve without electrically energizing the solenoid. The valve shall house a fully-encapsulated one piece solenoid.
- 4. The valve shall have a stainless steel flow control stem and cross handle for regulating or shutting off flow of water. The valve must open or close in less than one minute at 200psi.
- 5. The valve shall be sized to meet flow requirements shown on plans.
 - a. Potable irrigation system: Rain Bird EFB-CP IVM Series 2" valve
- E. Zone Control Valves for potable irrigation system.
 - 1. Globe valve shall be normally closed 24 VAC 50/60 cycle solenoid actuated with a pressure rating of not less than 200 psi.
 - 2. The valve body and bonnet shall be constructed of heavy duty glass filled UVresistant nylon and have stainless steel studs and flange nuts with a nylon reinforced nitrile rubber diaphragm.
 - 3. The valve shall have both internal and external manual open/close control to manual open and close the valve without electrically energizing the solenoid. The valve shall house a fully-encapsulated one piece solenoid.
 - 4. The valve shall have a brass flow control stem for accurate manual regulation and/or shut off of outlet flow.
 - 5. The valves shall be sized to meet flow requirements shown on plans.
 - a. Potable irrigation system: Rain Bird PE-IVM series valves
- F. Drip Zone Control Valve.
 - 1. Preassembled Zone Control Valve Assembly designed specifically for drip irrigation applications. The Zone Control Kit shall consist of a valve, ball valve, pressure regulator and 200 mesh filter.
 - 2. Globe configuration valve shall be normally closed 24 VAC 50/60 cycle solenoid actuated with a pressure rating of not less than 150 psi.
 - 3. The valve body and bonnet shall be constructed of high impact, weather resistant plastic, stainless steel and other chemical / UV resistant materials.
 - 4. The valve shall have a one unit diaphragm constructed of durable Buna-N rubber material with a clog resistant metering orifice and a double knife seal. The valve shall have one 90 mesh pilot filter attached to the diaphragm.
 - 5. The valve shall have one fully encapsulated solenoid with captured plunger. The valve shall have one 90-mesh filter attached to the solenoid base.
 - 6. The valve shall be capable of on/off control by turning the solenoid ¼ turn. The valve shall provide a flush mode that is manually activated by ½ turn of the bleed screw where external port is permissible.
 - 7. The pressure regulating filter body shall be constructed of heavy duty, glass filled, UV resistant plastic material with a pressure rating of not less than 150 psi. The filter element shall be constructed of a durable polyester fabric attached to a propylene frame and shall be serviceable for cleaning by unscrewing the cap from the body.
 - 8. The pressure regulator shall have a preset outlet pressure of approximately 40 psi in the 1" size and will accommodate an inlet pressure of not less than 150psi.

- 9. The valves shall be sized to meet flow requirements shown on plans.
 - a. Potable irrigation system: Rain Bird XCZ-100-IVM-Q series valves
- G. Pressure Regulating Module for regulating outlet pressure at control valve from 15 100 psi.
 - 1. The pressure regulating module shall be a two-piece devise consisting of a glass filled UV resistant nylon housing and dial cartridge. The regulator shall have visible pressure indication scale ranging from 0-100psi and an adjustable knob to provide fine tune adjustments in 1/3 psi increments.
 - 2. The regulator shall have a Schrader valve to accommodate a pressure hose gauge. The regulator shall be waterproof and provide regulation if the valve is manually internal bled or electronically activated.
 - 3. The Pressure Regulating Module shall be Rain Bird PRS-D.
- H. Quick Coupling Valve: Brass, Single piece construction, one inch female iron pipe size connection; vinyl covered brass hinged locking cover.
 - 1. Potable irrigation system: Yellow cap Rain Bird 44RC
- I. Manual Gate Valves (Isolation Valves): Non-rising stem, 125 lbs. brass body and parts with wedge disc filled for key operation, as supplied by Crane or equal.
- J. Pressure Relief Valves: As manufactured by Waterman, or equal.
- K. Valve Box Cover and Frame:
 - 1. Manufactures:
 - a. Rain Bird VB Series, manufactured by Rain Bird Corporation
 - b. Ametek plastic valve boxes, manufactured by Plymouth Products
 - c. or equal.
 - 2. Potable water irrigation system:
 - a. Turf Areas: Green Cover
 - b. Landscape Beds: Black Cover/Brown Cover
 - 3. Sizes:
 - a. 12" Standard; Rain Bird VB-STD
- L. Drainage Pit Backfill: Cleaned gravel or crushed stone, graded from 2" maximum to 3/4" minimum. AB3 or equivalent is not acceptable backfill material.

2.9 AUTOMATIC DRAIN VALVES

A. Description: Spring-loaded-ball type of corrosion-resistant construction and designed to open for drainage if line pressure drops below 2-1/2 to 3 psig.

2.10 SPRINKLER HEADS

- A. Manufacturer's standard unit designed to provide uniform coverage over entire area of spray shown on drawings at available water pressure.
 - Pop-up spray heads, 6" for turf: Rain Bird 1800 Series with plastic body, co-molded wiper seal, precision controlled flush at pop-down, built-in pressure regulator (PRS) built in the stem to maintain constant outlet pressure of 30 psi, designed for use with Rain Bird matched precipitation rate (MPR) plastic nozzles and high efficiency variable arc nozzles (HEVAN) in odd angle locations, installed using Rain Bird SA series swing assemblies. All pop-up spray heads are to have the built-in Seal-A-Matic (SAM) check valve.

2.11 LANDSCAPE DRIPLINE

- A. Flexible In-Line Drip Tubing
 - 1. Polyethylene tubing with factory installed, pressure compensating emitters with a spacing and consistent flow as listed on the plans.
 - 2. Pressure compensation will be accomplished through effective lengthening of the emitter flow path resulting with superior clog resistance.
 - 3. In-line emitter drip line shall have dual outlet ports to ensure direct contact with the ground.
 - 4. All drip tube to be staked in place using 12 gauge galvanized steel staples at 24"-36" OC.
 - 5. Rain Bird Easy Fit Compression Fitting System shall be used to connecting all drip tubing.
 - 6. In-line drip tubing shall be Rain Bird Landscape Dripline.
 - a. Potable water irrigation system XFD-06-18 in shrub beds
 - b. Potable water irrigation system XFD-09-12 in planters

2.12 SUBSURFACE IRRIGATION

A. Root Watering System (RWS): Manufacturer's standard unit designed to provide subsurface aeration and irrigation. RWS with subsurface bubbler, locking grate, below grade installation, self-contained and factory assembled units. Rain Bird RWS-B-C-1402-Sock.

2.13 AUTOMATIC CONTROL SYSTEM

- A. The irrigation controller shall be a Rain Bird ESP-LXIVM controller.
 - 1. The controller shall be housed in a wall-mountable, plastic locking cabinet suitable for either indoor or outdoor installation. The controller shall be capable of supporting up to 60 stations.
 - 2. The controller shall support up to 5 independently managed flow sensors interfaced with sensor decoders. The controller shall support up to five flow zones.

- 3. The controller shall incorporate a FloManager feature that shall provide real-time flow, power, and station management. FloWatch shall compare the current real-time flow rate to the learned rates and take user defined actions if problem is detected. FloWatch shall automatically determine the location of the flow problem and isolate the problem by turning off the affected station or master valve.
- 4. The controller shall be compatible with the IQ v4.0 Central Control System utilizing IQ-NCC Network Communication Cartridges providing remote computer control of the controller via a variety of communication options (Direct Connect Cable, Phone, GPRS/Cellular, Ethernet, WiFi, Radio, and IQNet Communication Cable).
- 5. Shall have the dimensions of:
 - a. Width: 14.32 in. (36.4 cm)
 - b. Height: 12.69 in. (32.2 cm)
 - c. Depth: 5.50 in. (14.0 cm)
- B. Surge Protection: Rain Bird Line Surge Protector IVM-SD (built in surge protection), required every 500' along two-wire path.
 - 1. Output power: Adjustable from controller Inrush and holding current valves adjustable at controller.
 - 2. Encapsulation: Fully waterproof
 - Address: Pre-coded from factory Electrical Input: Nominal voltage: 34Vpp (24V AC) from two-wire line. Minimum voltage: 21 Vpp (15V AC). Maximum Voltage: 36 Vpp (25V AC)
 - 3. Electrical Output:
 - a. Max. voltage: 36 Vpp
 - 4. Maximum Cable Runs: 14 gauge Star Pattern: 2.4 miles; Loop Pattern: 9.6 miles

Maximum Critical Path Lengths for 2-Wire Paths					
	01 10001	Max. Length For Critical Path			
Nominal Wire Size	Ohms per 1000 or Ohms per Km (per conductor) Miles	Star		Loop	
		Km	Miles	Km	Miles
2.5 mm2	7.5 0hms/Km	3.00	1.86	12.00	7.46
14 AWG	2.58 0hms/1000'	2.66	1.65	10.63	6.61
12 AWG	1.62 0hms/1000'	4.23	2.63	16.93	10.52

5. Decoder/Solenoid Wires - Electrical Resistance: Max. 3 ohms

- 6. Max. Distance Decoder/Solenoids: Cable length: 14 gauge: 456 feet
- 7. Wiring: Paige special direct burial irrigation control cable,
- 8. Environment: Working range: 32° to 122° F (0° to 50° C); storage range: -4° to 158° F (-20 to 70° C); Humidity: 100%
- 9. Surge Protection: 40 V, 1.5 kW transil

2.14 ELECTRIC WIRING

- A. 120 Volt AC Wiring: 120 volt service to controller shall consist of three wires: one black, one white, and one ground. Electrical service is to be provided by the General Contractor unless otherwise directed by Owner's Representative.
- B. Provide junction box, flush-mounted and gasketed per code as required.
- C. 2-Wire Control Wiring shall be dual core, tin-coated, double insulated special irrigation control wire. Minimum wire size shall be fourteen (14) gauge. Wire to be Maxi-cable as manufactured by Rain Bird® Corporation, Azusa, California or approved equal.
- D. Splices in controller wiring shall be waterproof direct bury application. Use Rain Bird-DBY T or R wire connectors. No substitutions will be allowed.

2.15 SURGE PROTECTION FOR THE TWO-WIRE PATH

- A. An IVM-SD shall be installed on the 2-wire communication path at each ESP-LXIVM controller location.
 - 1. The Rain Bird[™] IVM-SD Line Surge Protector decoder specifications include but are not limited to:
 - a. The line surge protector decoder shall be grounded on a two-wire path every 500 feet (150 meters) or every 15 valves, whichever is smaller.
 - b. Install one (1) within controller cabinet.
 - c. The IVM-SD Line Surge Protector decoder shall be placed on a two-wire path.
 - d. The IVM-SD Line Surge Protector decoder shall be used for surge protection only, and shall not have a decoder address.
 - e. The IVM-SD Line Surge Protector decoder shall protect against 40V, 1.5kW trasil.

2.16 GROUNDING

A. Controller, decoders and ancillary products used on a two-wire path shall be connected to a grounding system with a ground resistance of ten (10) ohms or less.

2.17 FLOW SENSOR

A. The flow sensor shall be an in-line type with a nonmagnetic, spinning impeller (paddle wheel) as the only moving part. The electronics housing shall have two, ethylenepropylene O-Rings and shall be easily removed from the meter body. The sensor electronics will be potted in an epoxy compound designed for prolonged immersion. Electrical connections shall be 2 single conductor 18 AWG leads 48 inches (1,2 meters) long. Insulation shall be direct burial "UF" type colored red for the positive lead and black for the negative lead. The sensor shall be capable of operating in line pressures up to 400 psi (27,5 bars) and liquid temperatures up to 220° F, and operating

in flows of $\frac{1}{2}$ foot per second to 15 feet per second with linearity of $\pm 1\%$ and repeatability of $\pm 1\%$. The meter body shall be cast 85-5-5-5 bronze, in 1" and $\frac{1}{2}$ ", female iron pipe thread sizes. This flow sensor shall be Rain Bird Model FS200P series

2.18 RAIN SENSOR

- A. Provide and install a Rain Bird wireless Rain Sensor (WR2-RFC) capable of turning off the irrigation system if adequate rainfall is received or freezing temperatures exist.
- B. Contractor to install per Rain Bird's recommendations and specifications. Location to be approved by Landscape Architect.
- C. Rain sensor shall employ an electro-mechanical actuating mechanism designed to cause a circuit interrupt if programmable low temperature or rainfall set points are satisfied.
- D. The device shall be used with 24VAC controllers and shall be of sufficient capacity to be used with a maximum of six 24VAC 7VA solenoids plus an additional master valve that does not exceed 53VA.
- E. The wireless rain sensor shall incorporate a provision that allows the installer to select from several rainfall or low temperature settings that can be programmed through the use of icons on a controller interface.
- F. A sensor LED shall communicate signal strength during the installation process.

2.19 EQUIPMENT

- A. The following list of items shall be submitted to the Owner prior to the final inspection of the irrigation system.
 - 1. 2 quick coupler valve keys, Rain Bird 44-K
 - 2. 2 hose swivel (1" x 3/4"), Rain Bird SH-2
 - 3. 2 gate valve keys (48")

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall install all irrigation system components in accordance with the Irrigation and Landscape Plans, Details and these Specifications.
- B. Schedule of Work: The Irrigation Contractor shall be responsible for the installation of the piping and equipment in a manner that will effect the earliest completion of the work in conformance with the construction progress schedules of other Contractors and Trades, and these Specifications.

- C. Observations: In addition to normal progress inspection, the Contractor shall give at least 48 hours notice to the Landscape Architect for inspection as follows:
 - 1. Layout of the system.
 - 2. Pressure tests.
 - 3. Coverage adjustment; Automatic operation.
 - 4. Punch list inspection.
- D. Quick Coupler Valves: Locate quick coupler valves on mainline runs only, near pavement surfaces, and adjacent to annual planting beds. Space quick coupler valves at maximum 100' intervals near parking lots, islands, building entries, sidewalks, entry monuments, and annual planting beds. Space quick coupler valves at maximum 200' interval for large turf areas.

3.2 PROTECTION

- A. The Contractor shall be responsible for storage of materials and any damage to the work covered by these Specifications before the final acceptance of the work.
- B. Protect work and materials from damage during construction. Storage of polyvinyl chloride (PVC) pipe and fittings shall be protected from direct sunlight. Beds on which materials are stored must be the full length of the pipe to avoid damage. Any pipe that has been damaged or dented shall not be used in the work.
- C. Any existing structures, equipment, utilities, pavement, landscaping, etc., damaged by Irrigation Contractor during the course of the work, including any damage caused by leakage or settling of piping systems being or having been installed by them, shall be restored at Contractor's expense and to the Owner's satisfaction.
- D. Securely cover openings into the system and cover apparatus, equipment, and appliances, both before and after being set in place, to prevent obstruction in the pipes and the breakage, misuse or disfigurement of the apparatus, equipment or appliances.

3.3 LAYOUT AND VERIFICATION

- A. The Contractor shall stakeout the locations of all piping, quick coupling valves, spray heads, rotors, and emitters in accordance with the irrigation design drawings. The Contractor shall check and verify dimensions of layout and report variations to the Landscape Architect before proceeding. Layout work as accurately as possible to the drawings.
- B. Minor changes in locations to the above from locations shown shall be made as necessary to avoid existing or proposed planting, piping, utilities, structures, etc., at the Contractor's expense, or when directed by the Landscape Architect, providing such change is ordered before such items or work directly connected to same are installed, and providing no additional materials are required.

- C. The Contractor will be held responsible for the relocating of any items without first obtaining the Landscape Architect's approval. The Contractor shall remove and relocate such items, at his expense; if so directed by the Landscape Architect.
- D. Before starting work on irrigation system, carefully check all grades to determine that work may safely proceed, keeping within the specified material depths. The Contractor shall be aware of the fact that the drawings are horizontal dimensions. Actual measurements taken along the slope of a bank will differ from those shown on the drawings.
- E. No fittings shall be installed on pipe underneath pavement or walls except where noted on the irrigation drawings. If such a need should occur, the Contractor shall bring it to the attention of the Landscape Architect.
- F. Exact sprinkler head placement is based on and shall be coordinated with actual planting layout and shall be verified by the Landscape Architect.
- G. All changes shall be recorded daily on the Record Drawings.

3.4 TRENCHING AND BACKFILLING

- A. Provide a minimum of 24" cover over top of PVC main line for potable irrigation systems, or per city code.
- B. Provide a minimum of 12" cover over top of PVC lateral piping for potable irrigation systems, or per city code.
- C. Backfill for irrigation lateral lines shall be with clean material from excavation. Remove organic material as well as rock and debris larger than 1" diameter. Irrigation piping shall have no rock or debris touching at any point along its length. A minimum of 6" clearance is required around all piping from all immovable obstructions. Place acceptable backfill material in 6" lifts, compacting each lift. Compact within 90% of the maximum density of the material used as determined by ASTM D-698 (Standard).
- D. Backfill trench to within 6" of finished grade. Continue fill with acceptable topsoil and compact to bring even with existing grade. Thorough compaction at each sprinkler head, valve, and piping will be required. Repair all settled areas.
 - 1. Under pavement areas contractor shall meet compaction requirements of pavement section plans and geotechnical report. Include flowable fill as required.
- E. Boring underneath existing pavement may be required. PVC sleeving for irrigation main line shall be installed underneath all pavements.
- F. Unless otherwise indicated, comply with requirements of the Uniform Plumbing code, city specifications, and all state or local codes.

3.5 TAPPING AND SUPPLY

A. Verify meter and backflow preventer have been installed at domestic tap. Ref: Civil plans.

B. Install irrigation mainline tap at backflow preventer. Coordinate with site contractor.

3.6 MASTER VALVE AND FLOW SENSOR

- A. Install master valve, flow sensor and pulse transmitter as per manufacturer's directions.
- B. Master valve and flow meter shall be installed in locking valve box per specification on detail sheets.

3.7 SLEEVING AND BORING

- A. Install sleeving at a depth which permits the encased wiring to remain at the specified depth.
- B. Extend the sleeve ends 6" beyond the edge of the paved surface. Cover pipe ends and mark with stakes.
- C. Install separate sleeve beneath paved areas to route each run of wiring. Any existing sleeving is not to be used without the consent of the Owner's Representative.
- D. Sleeving material beneath pedestrian pavements shall be PVC Class 200 pipe with solvent welded joints.
- E. Sleeving beneath drives and streets shall be PVC Sch. 40 pipe with solvent welded joints.
- F. Sleeving diameter shall be equal to twice the diameter of the wiring bundle.

3.8 CIRCUIT VALVES

- A. All valves shall be connected to main irrigation line in a plumb position. Each valve shall be installed in a valve box so that all parts of valve can be serviced. Valve boxes shall be installed over 6" of drainage gravel and shall be set so that the cover is flush with finish grade. Thorough compaction at valve boxes is required to bring the top of valve box 1" for turf and 2" for shrubs above finished grade after compaction and settlement has occurred. All settled valve boxes shall be raised prior to establishment acceptance.
- B. Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.
- C. Provide pressure regulation modules on the control valves for all zones that exceed recommended operating pressure by 5 psi as indicated in the irrigation zone schedule.

3.9 PIPING

A. Lay pipe in properly excavated trenches.

- B. For all mainline piping, slope to manual drain valve and drainage pit at least 1/2" in 10' of run.
- C. Install PVC pipe in dry weather when temperature is above 40 F in strict accordance with manufacturer's instructions. Allow joints to cure at least 24 hours at temperatures above 40 F (4 C) before testing, unless otherwise recommended by manufacturer.
- D. Manual Drain Valves: Install manual drain valves at all low points in main irrigation supply line. Record location on as-built drawings.
- E. Manual Gate Valves: Install manual gate valves at location shown on plan in main irrigation supply line. Record location on as-built drawings.
- F. Drainage Pits: 3 cu. ft. of clean gravel, minimum 18" deep, 1-1/12" 2" size, shall be located at all manual and automatic drain valves. Cover drainage pit with a soil separator and backfill to finish grade with excavated soil material.
- G. Sleeves: Install sleeves for all main line, laterals, and wire that cross roadways, drives, sidewalks, and all other paving surfaces. Sleeves shall be a minimum of 4" diameter, and shall be sized to accommodate all equipment necessary. Top of sleeves shall be a minimum of 24" below surface of paving. Sleeves shall extend a minimum of 12" behind back of curb. Permanently mark location of each end of sleeve on back of curb.

3.10 SPRINKLER HEADS

- A. Flush circuit lines with full head of water and install heads after hydrostatic test is completed.
- B. All sprinkler heads shall be set plumb at the elevation to be flush with finish grade.
- C. Contractor shall adjust, if necessary, the elevation of the sprinkler heads after finish grade and landscape plantings are complete.
- D. Install all sprinkler heads with pre-assembled swing-joints or swing-assemblies. Funny pipe will not be accepted for installation of any kind.

3.11 LANDSCAPE DRIPLINE

- A. Final installation of drip irrigation to occur after the trees, shrubs and other plant material has been installed.
- B. Flexible inline tubing or point source emitter tubing shall be used.
- C. Layout drip and distribution tubing as detailed on the plans to place drip tubing near root zone of the plantings. Install drip tubing at or near the surface of planting soil.
- D. Install one (1) OPERIND drip system operation indicator per drip zone at the furthest point of the drip zone from the remote control valve.
- E. Stake all drip tubing with steel stakes so that no movement of the pipe exists.

- F. Pressurize, flush and cap drip tubing.
- G. Cover drip tubing with specified depth of mulch.

3.12 SUBSURFACE IRRIGATION

- A. Flush circuit lines with full head of water and install heads after hydrostatic testing is completed.
- B. All rootwatering system heads shall be set plumb at the elevation to be flush with finish grade.
- C. Contractor shall adjust as necessary, the elevation of the rootwatering system heads after finish grade and landscape plantings are complete.
- D. Install all rootwatering system heads with pre-assembled swing-joints or swingassemblies. Funny pipe will not be accepted for installation of any kind.

3.13 CONTROLLER

- A. Controller shall be installed in permanent location as shown on plan and verified by Landscape Architect.
- B. Contractor shall properly programmed controllers for this particular job prior to substantial completion of this project.
- C. Control wire of system shall be 2 x 14 gauge, specifically designed for direct burial use. A minimum of 3'-0" of extra wire shall be spooled at each decoder location, at each splice, at each change in direction and at every 500 feet of straight run. At each termination of the mainline, an additional 6'-0" of wire shall be coiled and located within a valve box.
- D. Control wire shall be installed in multiple wire paths as shown on the plans.
- E. Wire shall be placed consistently along one side of the pipe in the trench. Splices and connections shall be watertight and leak proof, use Pin-Tight connections. Multiple wires in the trenches shall be banded together at 20-foot intervals for protection. Wire not along mainline pipe shall be placed within an electrical conduit.
- F. Install monitoring equipment including Weather Station, Flow Meter, and Soil Moisture Sensor. Electrical connections between controller and monitoring equipment shall be installed by contractor per manufacturer's recommendations. Irrigation contractor is responsible for all electrical power connections from power supply point adjacent to weather station.
- G. Install all surge protection as per manufacturer's latest instructions.
- H. Lightning protection: Drive three 8' copper-clad grounds into the soil. If soil conditions prevent proper penetration of the ground rods into the soil, contact the Landscape

Architect. Connect controller to grounding rod with AWG No. 10 Solid conductor copper wire. Secure wire to grounding rod with brass or bronze clamp.

- I. Install electrical connections between controller manufacturer's recommendations.
- J. Install all surge protection as per manufacturer's latest instructions.
- K. Lightning protection: Drive three 8' copper-clad grounds into the soil. If soil conditions prevent proper penetration of the ground rods into the soil, contact the Landscape Architect. Connect controller to grounding rod with AWG No. 10 Solid conductor copper wire. Secure wire to grounding rod with brass or bronze clamp.
- L. Irrigation Control Units
 - 1. The locations of the control units depicted on the drawings are approximate; the Owner's Representative, with assistance from the manufacturer's representative and the Landscape Architect, will determine the exact site locations at the system layout review.
 - 2. General Contractor will provide all communication drop location as designated on the plans. The irrigation contractor is responsible for all connections from stubout locations. Coordinate with General Contractor.
 - 3. General Contractor to provide all 120VAC power for control units. Coordinate location of power with Landscape Architect.
 - 4. Install electrical connections between central control unit components and satellite control units per manufacturer's recommendations.
 - 5. Install electrical connections between satellite control units and monitoring equipment per manufacturer's recommendations.
 - 6. Install all surge protection as per manufacturer's latest instructions.
 - Lightning protection: Drive three 8' copper-clad grounds into the soil. If soil conditions prevent proper penetration of the ground rods into the soil, contact the Owner's Representative. Connect controller to grounding rod with AWG No. 10 solid conductor copper wire. Secure wire to grounding rod with brass or bronze clamp.
 - 8. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with an identification number that consists of the name and station number of the existing controller to which the control wire had been previously connected.
 - 9. Connect control wire to corresponding control unit terminal. Connect wires to the satellite controller in the same order they are connected to the existing controller.
 - 10. Connection to controller per manufacture recommendation.
- M. Irrigation Control System Setup
 - 1. All irrigation schedules and programming shall be set up per manufacture recommendations.
 - 2. Contractor shall set up all modules including connection to all site controllers and sensors.

3.14 HYDROSTATIC TESTING

- A. Contact the Landscape Architect, while the necessary piping system components are exposed. All mainline piping is to be subjected to a hydrostatic test. Subcontractor is to supply all testing equipment including pump and all caps and gauges as required.
- B. Pressure gauges shall be read in PSI. Calibration shall be such that accurate determination of potential pressure loss can be ascertained. Test supply line at a pressure of 120 PSI for minimum of one hour with an allowable loss of 5 PSI.
- C. Re-test as required until the system meets the requirements. During the tests, regardless of the amount of leakage, all detectable leaks are to be stopped and all defects corrected.

3.15 ADJUSTING THE SYSTEM

A. Adjust alignment and coverage of all sprinklers and rotors if it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage. Make all necessary changes or make arrangements as directed by Landscape Architect. These changes or adjustments shall be made without additional cost.

3.16 RECORD DRAWINGS

- A. Indicate actual location of all valves and controls including piping. Show dimensions from easily identifiable existing features such as walls, curbs, fences, buildings, or walks. Submit diagram to the Landscape Architect for approval.
- B. Maintain progress drawings on the construction site at all times during installation of the irrigation system. Make a daily record of all work installed each day until completion of the work.
- C. Submit to Owner one (1) electronic version of the irrigation record drawings.
- D. Submit to Owner one (1) ¹/₂ size reduction of the irrigation record drawing, laminated both sides, for inclusion into the inside of the controller door.
- E. Submit to Owner two (2) full size plan sets of the irrigation record drawings.

3.17 ACCEPTANCE

- A. The ASP shall instruct the owner's designated personnel in the operation of the system pursuant to the training section already outlined in the specifications.
- B. The irrigation control system must be commissioned the ASP prior to final walk through of the system. The ASP shall confirm that the system is installed and grounded per the manufacture's recommendations. The Contractor shall address any system deficiencies found by the ASP prior to substantial completion.

3.18 GUARANTEE AND MAINTENANCE INSTRUCTIONS

- A. The Contractor shall fill and repair all depressions and replace all necessary lawn and planting due to the settlement of irrigation trenches for one year following the completing and acceptance of the job.
- B. The Contractor shall also guarantee all materials, equipment and workmanship furnished by him to be free of all defects of workmanship and materials, and shall agree to replace at his expense, at any time within one year after installation is accepted, any and all defective parts that may be found. Contractor shall transfer all manufacturer material warrantees to the Owner. All manufacturer warrantees shall be in effect for the period outlined in the manufacturer literature from the date of installation. Contractor shall detail these warrantees and provide all necessary information regarding them to the Owner in the record drawing submittals.
- C. The Contractor shall drain the irrigation system in the fall of the first year, and provide start up in the following spring.
- D. After the system is installed and approved, instruct the Owner or Owner's representative as to the complete operation and maintenance.

END OF SECTION 328400

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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Seeding.
 - 2. Hydroseeding.
 - 3. Sodding.

1.3 RELATED SECTIONS

- A. Section 328400 Planting Irrigation
- B. Section 329300 Plants

1.4 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. 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"] [Section 329115 "Soil Preparation (Performance Specification)"] and drawing designations for planting soils.
- D. 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.

1.5 INFORMATIONAL SUBMITTALS

- A. Prior to delivery to the job site, contractor shall submit to the Landscape Architect the source and supplier of all grass sod, seed, fertilizer, and other materials along with the type of equipment to be used on this project. 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.
- B. Certification of grass seed.
- C. Certification of each seed mixture for turfgrass sod.
- D. Product Certificates.

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. Regulatory Requirements
 - 1. Comply with applicable requirements of Federal, State, and Local laws, regulations and codes having jurisdiction at the project site.
 - 2. Contractor shall be responsible for certificates of inspection of plant material that may be required by Federal and Local authorities to accompany shipments of plants.
- B. Reference Standards
 - 1. "Standardized Plant Names" by the American Joint Committee of Horticultural Nomenclature.
 - 2. American National Standards Institute (ANSI); Publication Z60.1
- C. Coordination
 - 1. Work in conjunction with other trades as directed, taking all reasonable precautions to avoid disturbance or interference with any other operation or installation on the site. Contractors shall be responsible for the cost of replacing any material damaged as a result of his/her negligence.
- D. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

- 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
- 2. 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 Lawn Care Manager.
 - c. Landscape Industry Certified Lawn Care Technician.
- 3. Pesticide Applicator: State licensed, commercial.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other 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 JOB CONDITIONS

- A. Examination of Site:
 - 1. The bidder must acknowledge that he has examined the site, Drawings and Specifications and the submission of a quotation shall be considered evidence that examinations have been made.
- B. Field Conditions:
 - 1. The Contractor shall verify drawing dimensions with actual field conditions and inspect related work and adjacent surfaces. The Contractor shall report to the Landscape Architect all conditions which prevent proper execution of this work.

C. The Contractor shall determine the exact location of all existing utilities, structures, and geogrid reinforcement before commencing work. The Contractor shall conduct his work so as to prevent interruption of service or damage to them. The Contractor agrees to be fully responsible for any and all damage which might be occasioned by the Contractor's failure to exactly locate and preserve and all utilities, structures, and geogrid reinforcement.

SEQUENCING AND SCHEDULING

- D. Planting Restrictions: Proceed with and complete planting as rapidly as portions of the site become available, working within seasonal limitations for each kind of landscape work required. Recommended dates for seeding and sodding:
 - 1. Spring Planting: April 1 June 15.
 - 2. Fall Planting: September 1 December 15.
- E. 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.

MATERIALS CLEAN-UP

A. The Contractor shall keep the premises free from rubbish and all debris associated with their work at all times, and all unused materials and debris shall be removed the site and disposed of in a legal manner.

WARRANTY

- All plant material (lawns) shall be warranted for a period of not less than one
 (1) year from the date of issuance of the letter of Substantial Completion.
- B. All replacement stock shall be subject to the same warranty requirements as the original stock. Any damage due to replacement operations shall be repaired by the Contractor. At the end of the warranty period, inspections shall be made jointly by the Owner, Landscape Architect, and Contractor. All lawn areas not in healthy growing condition shall be removed and replaced with grasses of like kind and size before the close of the next planting season and before issuance of the letter of Final Completion.

PART 2 - PRODUCTS

- 2.1 SEED
 - A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
 - B. Seed Species:
 - 1. Quality, State Certified: State-certified seed of grass species as listed below for solar exposure.
 - 2. Quality, Non-State Certified: Seed of grass species as listed below for solar exposure, with not less than 85 Insert number percent germination, not less than 95 Insert number percent pure seed, and not more than 0.5 Insert number percent weed seed:
 - 3. Full Sun, Cool-Season Grass: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
 - 4. Sun and Partial Shade, Cool-Season Grass: Proportioned by weight as follows:
 - a. 50 percent Kentucky bluegrass (Poa pratensis).
 - b. 30 percent chewings red fescue (Festuca rubra variety).
 - c. 10 percent perennial ryegrass (Lolium perenne).
 - d. 10 percent redtop (Agrostis alba).
 - 5. Shade, Cool-Season Grass: Proportioned by weight as follows:
 - a. 50 percent chewings red fescue (Festuca rubra variety).
 - b. 35 percent rough bluegrass (Poa trivialis).
 - c. 15 percent redtop (Agrostis alba).

2.2 TURFGRASS SOD

- A. Turfgrass Sod: Certified Approved 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, Cool-Season Grass: Sod of grass species as follows, with not less than 85 Insert number percent germination, not less than 95 Insert number percent pure seed, and not more than 0.5 Insert number percent weed seed:
 - 1. Full Sun: Kentucky bluegrass (Poa pratensis), a minimum of three cultivars.
 - 2. Sun and Partial Shade: Proportioned by weight as follows:
- a. 50 percent Kentucky bluegrass (Poa pratensis).
- b. 30 percent chewings red fescue (Festuca rubra variety).
- c. 10 percent perennial ryegrass (Lolium perenne).
- d. 10 percent redtop (Agrostis alba).
- 3. Shade: Proportioned by weight as follows:
 - a. 50 percent chewings red fescue (Festuca rubra variety).
 - b. 35 percent rough bluegrass (Poa trivialis).
 - c. 15 percent redtop (Agrostis alba).

2.3 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. 1 lb/1000 sq. ft. Insert value of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
 - b. 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. 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
 - b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.4 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

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.

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/Engineer 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 adjacent and adjoining areas from hydroseeding and hydromulching overspray.

- 2. 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.
- C. Before planting, obtain Landscape Architect's acceptance of finish grading, restore planting areas if eroded or otherwise disturbed after finish grading.

3.3 TURF AREA PREPARATION

A. General:

- 1. Clearing
 - a. All areas of turf establishment are to be cleared by the Contractor.
 - b. Clearing shall consist of the satisfactory removal and disposal of brush, rubbish, and other vegetative growth occurring within all proposed turf areas unless turf is being overseeded. All debris associated with this work shall be gathered and removed from the Project by the Contractor.
- 2. Preparation of Planting Mixture
 - a. Mix recommended soil amendments and fertilizers with topsoil at rates recommended by the soil test results. Delay addition of fertilizer if planting mixture will not be used within two (2) days.
- 3. Protection of Existing Vegetation
 - a. All areas under drip lines of existing trees shall be kept free of construction equipment, trailers, material storage, and vehicles.
 - b. Exercise extreme care when working around existing trees to remain. No soil scarification or compaction from construction vehicles shall occur under any existing tree dripline.
 - c. In areas of established turf, the surrounding turf area shall be covered in a manner that will provide protection before excavations begin for sodded turf.
- B. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- 3.4 SEEDING
 - A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.
 - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 - 2. Do not use wet seed or seed that is moldy or otherwise damaged.

- 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a manufacturer's recommended rate for new lawns.
- C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blanket s and 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
- F. Protect seeded areas from hot, dry weather or drying winds by applying planting soil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.5 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, commercial fertilizer slow-release fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
 - 1. Mix slurry with non-asphaltic tackifier.
 - 2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
 - 3. Spray-apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre.

3.6 SODDING

- A. All sod areas indicated on the plans shall have temporary cover removed, fine graded and sodded as specified herein and in strict accordance with standard horticultural practices.
- B. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

- C. 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.
- D. As sodding is completed in any one section, the entire area shall be rolled or tamped to insure solid contact of roots with the soil surface. Sod shall be watered immediately after rolling and tamping until the underside of the new sod pad and soil surface below the sod are thoroughly moistened. The operations of laying, tamping and watering for any piece of sod shall be completed within eight (8) hours.
- E. 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.

3.7 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. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
 - 3. 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 turf-type tall fescue to a height of 2 to 3 inches.
- D. Turf Postfertilization: Apply commercial fertilizer slow-release fertilizer after initial mowing and when grass is dry.
 - 1. Use fertilizer that provides actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.8 SATISFACTORY TURF

- A. Turf installations shall meet the following criteria as determined by Architect/Engineer:
 - 1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.
 - 2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, wellrooted, 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. Apply pesticides and other chemical products and biological control agents according to requirements of 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. 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

- A. The Contractor shall maintain sod and seed areas by weeding and mowing as required for healthy growth until issuance of the letter of Substantial Completion for the entire site and scope of work.
- B. The Contractor shall be responsible for watering sod areas until the new irrigation system is completely functional and the letter of Substantial Completion has been issued. Contractor shall be responsible for watering sod areas by hand where irrigation system does not cover. Hand watering of these areas shall continue until letter of Substantial Completion has been issued. Watering shall supplement natural rainfall and shall assure that the sod areas receive a minimum of one (1) inch of water per week. Sod shall be watered daily during the first week and in sufficient quantities to maintain moist soil to a depth of four inches (4"). After the first week sod shall be watered as necessary to maintain adequate moisture.

END OF SECTION

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. The Contractor shall furnish all labor, materials, tools, equipment, supervision, and services necessary to install plant material, preparation of soil, fine grading, planting, mulching, guying, pruning, watering, and the proper disposal of any excess earth or debris, all in accordance with the accompanying Drawings and these Specifications.
- 1.2 SUMMARY
 - A. Section Includes:
 - 1. Plants.
 - 2. Mulches.
 - 3. Tree stabilization.
 - 4. Tree-watering devices.
 - 5. Landscape edgings.

1.3 RELATED SECTIONS

- A. Section 328400 Planting Irrigation
- B. Section 329200 Turf and Grasses

1.4 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- 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. Some sources classify herbicides separately from pesticides.
- C. 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.

D. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

1.5 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.
- 1.6 ACTION SUBMITTALS
 - A. Product Data: For each type of product.
 - B. Samples of each type of mulch.
- 1.7 INFORMATIONAL SUBMITTALS
 - A. Product Certificates
 - B. Sample Warranty
- 1.8 CLOSEOUT SUBMITTALS
 - A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year.

1.9 QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Comply with applicable requirements of Federal, State, and Local laws, regulations and codes having jurisdiction at the project site.
 - Contractor shall be responsible for certificates of inspection of plant material that may be required by Federal and Local authorities to accompany shipments of plants.
- B. Reference Standards
 - 1. "Standardized Plant Names" by the American Joint Committee of Horticultural Nomenclature.
 - 2. "American Standard of Nursery Stock" by the American Association of Nurseryman.
 - 3. American National Standards Institute (ANSI); Publication Z60.1.

C. Substitutions

- 1. Substitutions of plant material will not be permitted unless authorized in writing by Owner or Landscape Architect. If proof is submitted that any plant specified is not obtainable, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of Contract Price. Such proof shall be substantiated and submitted in writing to the Owner and Landscape Architect at least thirty (30) days prior to start of the work under this Section. These provisions shall not relieve the Contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.
- D. Condition and Source of Plants
 - 1. Plants shall be subject to review and approval by the Owner or Landscape Architect upon delivery for conformity to Specifications. Such approvals shall not impair the right of review and rejection during progress of the Work. Submit written request for inspection of plant material at place of growth and quantity of plants to be inspected.
- E. Coordination
 - 1. Work in conjunction with other trades as directed, taking all reasonable precautions to avoid disturbance or interference with any other operation or installation on the site. Contractors shall be responsible for the cost of replacing any material damaged as a result of his/her negligence.
- F. Installer's Field Supervision: Require Installer to maintain an experienced fulltime supervisor on Project site when work is in progress.
 - 1. Pesticide Applicator: State licensed, commercial.
- G. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Storage of Materials
 - 1. All materials delivered to the job shall be stored so as to keep them in new condition and free from deterioration. Peat moss, fertilizer, etc., shall be stored in temporary sheds off-site at Contractor's expense.
- B. Packaged Materials
 - 1. 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.
- C. Plant Material

- 1. Plants shall not be delivered to the site until the corresponding beds are fully prepared. All shipments of nursery materials shall be thoroughly protected from the sun and from drying winds during transit. All plants which cannot be planted at once after delivery to the site of the work shall be well protected against the possibility of drying by wind and sun. Balls of earth on B&B plants shall be kept covered with soil or other acceptable material. All materials heeled-in on the property shall be adequately watered.
- 2. 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.
- 3. Handle planting stock by root ball.
- 4. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.
- 5. 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.
- 6. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
- 7. Do not remove container-grown stock from containers before time of planting.
- 8. 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 JOB CONDITIONS

- A. Examination of Site:
 - 1. The bidder must acknowledge that he has examined the site, Drawings and Specifications and the submission of a quotation shall be considered evidence that examinations have been made.
- B. Field Conditions: The Contractor shall verify drawing dimensions with actual field conditions and inspect related work and adjacent surfaces. The Contractor shall report to the Landscape Architect all conditions which prevent proper execution of this work.
- C. The Contractor shall determine the exact location of all existing utilities, structures, and geogrid reinforcement before commencing work. The Contractor shall conduct his work so as to prevent interruption of service or damage to them. The Contractor agrees to be fully responsible for any and all damage which might be occasioned by the Contractor's failure to exactly locate and preserve any and all utilities, structures, and geogrid reinforcement.

1.12 SEQUENCING AND SCHEDULING

- A. Planting Time: Proceed with and complete planting as rapidly as portions of the site become available, working within seasonal limitations for each kind of landscape work required.
- B. Planting Dates:
 - Trees, shrubs, and perennials shall be planted only when the ground is not frozen, snow covered, or in an otherwise unsuitable condition for planting. Spring planting shall generally occur between Feb 15 and May 31, and fall planting shall generally occur between September 1 and Dec 15.

1.13 MATERIALS CLEAN-UP

A. The Contractor shall keep the premises free from rubbish and all debris associated with their work at all times and all unused materials and debris shall be removed from the site.

1.14 WARRANTY

- A. All plant material (trees, shrubs, etc.) and planting supplies (bark mulch, etc.) shall be warranted for a period of not less than one (1) year from the date of issuance of the letter of Substantial Completion.
- B. All replacement stock shall be subject to the same warranty requirements as the original stock. Any damage due to replacement operations shall be repaired by the Contractor. At the end of the warranty period, inspections shall be made jointly by the Owner, Landscape Architect, and Contractor. All plants not in a healthy growing condition shall be removed and replaced with plants of a like kind and size before the close of the next planting season and before issuance of the letter of Final Completion.
- C. 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.

PART 2 - PRODUCTS

- 2.1 TOPSOIL
 - A. Topsoil shall be fertile, natural topsoil, typical of the locality. Stockpiled topsoil may be used. It shall be free of subsoil, slag, clay, stones, lumps, sticks, plants or their roots, toxic substances or other extraneous matter that may be harmful to plant growth or would interfere with future maintenance. Topsoil pH range shall be 6.0 to 7.0.
 - B. Soil Testing:
 - Onsite Topsoil The Contractor shall be responsible for having onsite topsoil tested by the Local County Extension Office to determine the amounts of amendments needed to meet the desired pH, nutritional organic levels determined to be adequate for the area by the County Extension Agent. The Contractor shall submit topsoil tests to the Landscape Architect.
 - 2. Offsite Topsoil The Contractor shall be responsible for having offsite imported topsoil tested by the Local County Extension Office to determine the amounts of amendments needed to meet the desired pH, nutritional organic levels determined to be adequate for the area by the County Extension Agent. The Contractor shall submit topsoil tests to the Landscape Architect.
 - C. Soil Conditioners and Amendments:
 - 1. Aluminum sulfate shall be horticultural grade.
 - 2. Peat shall be a natural product of sphagnum peat (peat moss), derived from a fresh-water site conforming to ASTM D 2607 except as otherwise specified. Peat shall be shredded and conditioned in storage piles for at least 6 months after excavation.
 - 3. Sand shall be clean and free of toxic materials.
 - 4. Vermiculite shall be horticultural grade and free of any toxic materials.
 - 5. Rotted manure shall be unleached stable or cattle manure not less than 8 months or more than 2 years old, containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; and containing no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds.
 - 6. Rotted sawdust shall have 7.5 pounds of nitrogen added uniformly to each cubic yard and shall be free of chips, stones, sticks, soil, and toxic substances.
 - 7. Gypsum shall be 90 percent pure, free of any toxic materials, and at least 95 percent by weight shall pass a 4-mesh sieve.
 - 8. Other amendments as recommended by County Extension Agent.
 - D. Treatment of Saline Soil: Saline soil shall be leached out by a controlled amount of water sufficient enough to leach the salts to a level below the root zone. Water used for this purpose shall have a low salt content.

2.2 PLANTING SOIL MIXTURE

- A. The "topsoil mixture" shall be composed of on-site or off-site topsoil and additional soil amendments appropriate for the location and plantings based on the soil test provided in the appendix.
- B. The "planting soil mixture" for all planting pits shall be 80% topsoil mixture, 10% peatmoss, and 10% well composted manure. Mix thoroughly for uniformity of texture and distribution before placing in pit.
- C. The "planter soil mixture" for all planters shall be 60% topsoil mixture, 10% peatmoss, 10% well composted manure and 20% clean sand. Mix thoroughly for uniformity of texture and distribution before placing in planter.

2.3 PLANT MATERIAL

- A. Plant material shall be first quality stock and shall conform to the code of standards set forth in the current edition of the American Standards of Nursery Stock sponsored by the American Association for Nurserymen, Inc.
- B. 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.
- C. 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 Landscape Architect, with a proportionate increase in size of roots or balls.
- D. 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.
- E. Species and variety as specified on the Drawings and delivered to the site shall be certified true to their genus, species and variety and as defined within the current edition of "Standardized Plant Names" by the American Joint Committee of Horticultural Nomenclature.
- F. The Contractor shall facilitate inspection and identification by labeling of trees, shrubs, and perennials with a durable waterproof label and weather-resistant ink. Labels shall state the correct plant name and size as specified in the plant list of required plants. Labels shall be securely attached to plants and shall be legible for 60 days after delivery to the planting site. Wire identification tags shall not be used. Plants not labeled will be rejected. The Contractor shall remove all tags after the Landscape Architect's acceptance of the installation.

- G. Plants shall be nursery grown and shall be of varieties specified in the plant list bearing botanical names.
- Planting stock shall be well-branched and well formed, sound, vigorous, healthy, free from disease, sun-scale, windburn, abrasion, and harmful insects or insect eggs; and shall have healthy, normal unbroken root systems. Deciduous trees and shrubs shall be symmetrically developed, of uniform habit of growth, with straight trunks or stems, and free from objectionable disfigurements. Evergreen trees and shrubs shall have well-developed symmetrical tops with typical spread of branches for each particular species or variety. Evergreen trees and shrubs shall not be sheared. Plants shall have been grown under climatic conditions similar to those in the locality of the project. Deciduous plants shall be dug in a dormant stage only.
- I. Stock Sizes: All stock measurements caliper, height, branching level, number of canes, ball sizes shall be in strict accordance with the latest edition of the American Standard for Nursery Stock, unless otherwise noted on the plans. Plants used on the project shall meet or exceed all minimum requirements indicated in the size, condition, and remarks sections of the planting legend on the plan sheets.\
- J. All stock shall be balled and burlapped or container grown stock. Bareroot stock of any kind is unacceptable.

2.4 FERTILIZERS

- A. All fertilizers shall be horticultural grade complete formula fertilizers and shall conform to the applicable State Fertilizer Laws.
- B. Plant Stock: Fertilizer shall be "AGRIFORM" slow-release fertilizer tablets. To be applied per manufacturer's specifications. Perennials areas: Fertilizer shall be applied at the same rate as the lawn areas.

2.5 MYCORRHIZAL

- A. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.
- B. All mycorrhizal shall be horticultural grade complete formula mycorrhizal and shall conform to the applicable State Mycorrhizal Laws.
- C. MYKE Pro Landscape Granular Mycorrhizal Inoculant
 - 1. Distributor: Subject to compliance with requirements, provide products by the following:
 - 2. Arbor Valley Nursery, Brighton, CO, (303) 654-1682, Arbor Valley Nursery.com

3. For approved equal, reference specific written instructions from manufacturer

2.6 MULCHES FOR PLANTINGS

- A. Hardwood Mulch: Mulch in all open planting beds labeled as hardwood mulch shall be shredded double ground oak or dark hardwood mulch of its natural color. Cypress, or dyed or colored mulch is unacceptable. Bark shall be of a relative uniform particle size with a median size of one and one-half inches (1-1/2") and shall be free of sticks, stones, leaves and any other debris.
- B. Rock Mulch: Mulch in all open landscape beds labeled as rock mulch shall be Salt and Pepper River Jacks 2"-4" or 4"-10" as supplied by House of Rocks in Kansas City, KS 913.432.5990, or approved equal. Weed preventative fabric shall be included within rock areas.

2.7 GEOTEXTILE FILTER FABRIC

A. Woven Geotextile Filter Fabric: Polypropylene fabric, 3.5 oz to 4.0 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.

2.8 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.

2.9 TREE-STABILIZATION MATERIALS

- A. Trunk-Stabilization Materials:
 - 1. Steel "T" bar fence post, 8' long, painted dark green with the top 6" painted white

- C. Tree tie systems shall be easily adjustable, strong in all weather, and easily attached and removed. Hose and wire are not acceptable for staked trees. Tree tie systems shall be the following or approved equal:
 - 1. Cinch Ties, J. Lichtenthaler P.O. Box 938 Cerritos, CA 90701
 - 2. Adj-A-Type Heavyweight only, plastic chain twist tie
 - A.M. Leonard and Sons Piqua, Ohio 43356 Plastic Binder Tye, tie with tapered beads that snap lock

2.10 EDGING

- A. Shrub bed edge adjacent to turf areas shall be black powder coat steel 3/16" x 4"x 16' edging as manufactured by Sure-Loc Edging. or approved equal. 1.800.787.3562
- B. Bed edging adjacent to concrete curb, pavement and sidewalk shall be manicured "V" edge per details.

2.11 WATER

A. Water shall not contain elements toxic to plant life. It shall be the Contractor's responsibility to obtain water to be used for watering of plant material.

2.12 TREE-WATERING DEVICES

- A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over an extended time period; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BIO-PLEX, Water-It-Well 18 Gal.
 - b. Spectrum Products, Inc., Treegator Original Slow Release Watering Bag
 - 2. Color: Green

2.13 MISCELLANEOUS PRODUCTS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- B. Burlap: Non-synthetic, biodegradable.
- C. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D448 for Size No. 8 Insert requirements.
- D. Planter Filter Fabric: Woven geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.
- E. Trunk Wrapping Material: Tree wrap products shall be two thicknesses of crinkled paper cemented together with a layer of bituminous material. Wrapping material shall be a minimum of 4" inches in width and have a stretch factor of 33 1/3 percent. Twine for tying shall be a grafting cord.

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 GENERAL 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.
- 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.
- E. Preparation of Planting Soil Mixture
 - 1. Mix recommended soil amendments and fertilizers with topsoil at rates recommended by the soil test results. Delay addition of fertilizer if planting mixture will not be used within two (2) days.
- F. Protection of Existing Vegetation
 - 1. All areas under drip lines of existing trees shall be kept free of construction equipment, trailers, material storage, and vehicles.
 - 2. Exercise extreme care when working around existing trees to remain. No soil scarification or compaction from construction vehicles shall occur under any existing tree dripline.
 - 3. In areas of established turf, the surrounding turf area shall be covered in a manner that will provide protection before excavations begin.

3.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil Coordinate
- B. Placing Planting Soil: Place manufactured planting soil over exposed subgrade.
- C. Before planting, restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: At time of planting, apply dry product uniformly over prepared soil at application rate according to manufacturer's written recommendations.
- 3.4 EXCAVATION FOR TREES AND SHRUBS
 - A. Planting Pits and Trenches: Excavate circular planting pits.

- 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 for balled and burlapped stock.
- 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 may not be used as backfill and the top six (6) inches of topsoil removed from excavations, if free from subsoil, clay, rocks, roots, or other debris, may be utilized in the topsoil mixture as specified.
- C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
 - 1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into freedraining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

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 and Container-Grown Stock: Balled and burlapped and container grown plants shall be handled and moved only by the ball or container. Container-grown stock shall be removed from containers without damaging plant or root system. Set each plant plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.
 - 1. Backfill: Planting soil as specified.
 - 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. Apply Mycorrhizal to root ball according to manufacturer's recommended rates. Inoculant must be physically rubbed onto the root ball thoroughly prior to backfilling planting hole.
 - 4. 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.
 - 5. 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 from root tips; do not place tablets in bottom of the hole.
 - a. Quantity: Per manufacturer's recommended rates.
 - 6. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. 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 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 Landscape 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.

3.7 TREE STABILIZATION

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
 - 1. Upright Staking and Tying:
 - a. Trees shall be staked and guyed as indicated on plans within 24 hours of planting.
 - b. Stakes shall be driven vertically into the ground to a depth specified in details and in such a manner as to not damage the ball or roots.
 - c. Tree tie systems shall be installed as per manufacturer specifications.
 - d. All trees 2-1/2 inches in caliper or less shall be staked with two stakes. All trees greater than 2-1/2 inches in caliper shall be staked with three stakes, spaced equal distant around the tree.
 - 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.

3.8 TREE WRAPPING

- A. Deciduous trees planted in specified fall timeframe shall have their trunks wrapped with 24 hours after planting.
- B. Apply specified tree wrap per manufacturer's recommendations and specifications.
- 3.9 PLACING SOIL IN PLANTERS
 - A. Wrap a layer of drainage gravel at least 4 inches thick in bottom of planter with filter fabric. Secure the filter fabric wrapped drainage gravel with duct tape to prevent soil from migrating into the drainage gravel layer during the soil-filling process.
 - B. Fill planter with planting soil. Place soil in lightly compacted layers to an elevation of 1-1/2 inches below top of planter, allowing natural settlement.

3.10 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 specified planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.11 PLANTING AREA MULCHING

- A. Prior to installation of mulch, all areas to be covered shall be weed free and treated with the specified pre-emergent herbicide.
- B. Mulching shall take place within 48 hours after planting.
- C. Mulch backfilled surfaces of planting areas and other areas indicated.
 - 1. Trees in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
 - 2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.
 - 3. Rock Mulch: For 2"-4" size apply 6-inch average thickness of rock mulch over whole surface of area. For 4"-10" size apply 4-inch average thickness of rock mulch over whole surface of area. Do not cover or damage plant material when placing rock mulch.
 - 4. Mulch shall be kept off walls, sidewalks, light standards, and other structures.
 - 5. The top of all areas covered with mulch shall be 1-inch below the top of adjacent curb, walk, wall, wall cap, or edge of pavement.

3.12 INSTALLATION OF EDGING

A. Steel Edging: Install steel edging where indicated on the Drawings according to manufacturer's written instructions.

3.13 INSTALLATION OF SLOW-RELEASE WATERING DEVICE

- A. If irrigation system is not operational at time of planting, provide one device for each tree.
- B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.
- C. Remove watering devices from trees once irrigation system is fully operational.

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.

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 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.

3.17 PLANT MAINTENANCE

- A. The Contractor shall maintain trees, shrub, and other plants by pruning, cultivating, and weeding as required for healthy growth until issuance of the letter of Substantial Completion for the entire site and scope of work. The Contractor shall tighten and repair stake and tree tie systems, reset trees and shrubs to proper grades or vertical position, restore or replace damaged wrappings, and apply herbicide and pesticides to keep trees, shrubs, and other plant material free of insects and disease as required until issuance of the letter of Substantial Completion.
- B. The Contractor shall be responsible for watering trees, shrubs, and other plant material until the new irrigation system is completely functional and the letter of Substantial Completion has been issued. Contractor shall be responsible for watering trees by hand where tree root watering irrigation does not occur. Hand watering of these trees shall continue for 90 days after letter of Substantial Completion has been issued. Watering shall supplement natural rainfall and shall assure that the trees, shrubs, and other plant material receive a minimum of 1-inch of water per week.

END OF SECTION