

SECTION 033519 - INTEGRALLY COLORED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Integrally colored finishes for site-cast concrete.
2. If this Section conflicts with Related Sections:
 - a. This Section takes precedence for matters that affect concrete appearance.
 - b. Related Sections take precedence for matters that do not affect concrete appearance.
 - c. In case of conflicts, notify Architect for clarification.

1.2 REFERENCE STANDARDS

- A. ACI 301 – Structural Concrete.
- B. ACI 303.1 – Cast-in-Place Architectural Concrete.
- C. ACI 305.1 – Hot Weather Concreting.
- D. ACI 306.1 – Cold Weather Concreting.
- E. ACI 308R – Curing Concrete.
- F. ACI 318 – Building Code Requirements for Structural Concrete.
- G. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete.
- H. ASTM C979 – Pigments for Integrally Colored Concrete.

1.3 SUBMITTALS

A. Product Data:

1. Color additives.
2. Curing products.
3. Proprietary cleaning agents.
4. Surface retarders.

B. Shop Drawings: Indicate extent of each color of integrally colored concrete.

C. Samples for Initial Selection: Submit color additive manufacturer's color sample chip set.

D. Samples for Verification: Submit sample chip of specified concrete colors indicating Davis color name.

E. Qualification Data: For Installer.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with: ACI 305.1, ACI 306.1, ACI 318.

- B. Obtain each material from same source and maintain high degree of consistency in workmanship throughout Project.
- C. Installer Qualifications: Concrete work shall be by firm with [five]<Other number> years experience with work of similar scope and quality.
- D. Field Samples: Submit 3 three samples 24 by 24 inches indicating concrete color range and texture on site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Color Additive: Deliver, store, and handle in accordance with manufacturer's instructions.
- B. Concrete: Schedule delivery to provide consistent mix times from time color additive is placed in mixture until placement of integrally colored concrete.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

- A. Portland cement: ASTM C150, Type 1, natural color.
- B. Aggregate: Provide AASHTO M43 Grading #57 clean, uncoated crushed stone or gravel coarse aggregate free of materials which cause staining or rust spots; fine aggregate shall be clean natural sand.
- C. Water: Clean, fresh, and potable.
- D. Air-entraining admixture: ASTM C260.
- E. Water-reducing admixture: ASTM C494.

2.02 MIXES

- A. Provide ASTM C94 ready-mixed concrete. Batch mixing at site not acceptable.
 - 1. Strength: 4,000 psi minimum at 28 days.
 - 2. Slump range: 2" to 4" maximum.
- B. Provide an approved water-reducing admixture in all concrete.
- C. Provide an air-entraining admixture in all concrete. Air content 5% to 7%.
- D. Indicate water added to mix at job site on each delivery ticket. Show quantity of water added. Site water tempered mixes exceeding specified slump range will be rejected as not complying with specification requirements.

2.03 ACCESSORIES

- A. Granular base: No. 57 uniformly graded, clean crushed stone.

- B. Forms: Wood or metal of sufficient strength to resist concrete placement pressure and to maintain horizontal and vertical alignment during concrete placement. Provide forms straight, free of defects and distortion, and height equal to full depth of concrete work.
- C. Joint filler: ASTM D1751, premolded non-extruding asphalt-impregnated fiberboard, thickness indicated.
- D. Reinforcing steel: ASTM A615, A616, or A617, Grade 40, new domestic deformed steel bars.
- E. Form release agent: Non-staining chemical form release agent free of oils, waxes, and other materials harmful to concrete.
- F. Caulking: ASTM C-920, type I, single component, slope grade, polyurethane caulk. Color to be approved by Landscape Architect.

2.2 COLOR ADDITIVES

A. Manufacturers:

- 1. Davis Colors
Contact Information:
Phone: 800-356-4848 or 323-269-7311.
E-mail: info@daviscolors.com.
Web Site: www.daviscolors.com.
- 2. L. M. Scofield Company
4155 Scofield Rd.
Douglasville, GA 30134
Phone: (770) 920-6000
Fax: (770) 920-6066
- 3. Solomon Colors
4050 Color Plant Road
Springfield, IL 62702
P 217.522.3112
Toll Free 800.624.0261
Fax 800.624.3147

B. Type:

- 1. Concentrated pigments specially processed for mixing into concrete and complying with ASTM C979.
- 2. Color additives containing carbon black are not acceptable.

C. Color Additive Delivery:

- 1. Automated Dispensing: Meter and dispense colors using computer-controlled automated color weighing and dispensing system.
- 2. Manual Dispensing: Use powdered color additives in pre-measured disintegrating bags.

2.3 CONCRETE FLATWORK

- A. Surface Retarder: if recommended by manufacturer.

- B. Curing Compound for Flatwork: tinted to match integrally colored concrete]; complying with ASTM C309 and designed for use on integrally colored concrete.
- C. Moist Curing Blankets: disposable curing blankets designed for use on colored or decorative concrete and to keep surface of concrete moist for seven days.

2.4 CONCRETE COLORS

- A. Concrete Colors: provide color to match mid-range hue of specified concrete pavers. Color to be approved by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not place integrally colored concrete where standing water is present.

3.2 INSTALLATION

- A. Comply with color admixture manufacturer's recommendations unless otherwise specified in this Section.

3.3 FLATWORK

A. Finishing:

1. Broom Finish: Pull broom across freshly floated concrete to produce fine texture in straight lines parallel to main line of traffic. Do not dampen brooms.
2. Trowel Finish: Provide smooth surface. Do not start troweling late.

B. Curing

1. Apply curing compound for flatwork or moist curing blanket in accordance with manufacturer's instructions. Apply curing at consistent time for each pour.
2. Maintain concrete between 65° and 85°F during curing.

3.4 APPEARANCE TOLERANCES

- A. Appearance: Minor variations in appearance of integrally colored concrete that are similar to natural variations in color and appearance of uncolored concrete are acceptable.

3.5 CLEANING

- A. Efflorescence: Remove efflorescence as soon as practical after it appears and as part of final cleaning].
- B. Use least aggressive cleaning techniques possible
- C. If proprietary cleaning agents are used, pre-wet surface, test cleaning agent on small, inconspicuous area, and check effects prior to proceeding. Thoroughly rinse surface afterwards with clean water. Follow cleaner manufacturer's instructions.
- D. Do not use muriatic or hydrochloric acid on integrally colored concrete.

END OF SECTION

SECTION 034500 - PRECAST ARCHITECTURAL CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Precast Concrete Stairs
 - 2. Precast Concrete Caps
 - 3. Precast Concrete Copings
 - 4. Precast Concrete Wall Panels
 - 5. Precast Concrete Base
 - 6. Setting Material, Grouts, Sealants and caulks.

1.2 DEFINITION

- A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
 - 1. Loads: As indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
- C. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
 - 1. Comprehensive engineering analysis certified by the qualified professional engineer responsible for its preparation. Show governing panel types, connections, and types of reinforcement, including special reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from architectural precast concrete.

- D. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 6 by 6 inches (150 by 150 mm).
- E. Color Range: Color range for Architect's consideration will be in the Beige or Cream range.
- F. Welding certificates.
- G. Material test reports: For aggregates.
- H. Material Certificates: Signed by manufacturers:
- I. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering architectural precast concrete units to comply with performance requirements. This responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Design Standards: Comply with ACI 318 (ACI 318M) and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
- C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
- D. Welding: Qualify procedures and personnel according to AWS D1.1/D.1.1M, "Structural Welding Code - Steel"; and AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- E. Sample Panels: After sample approval and before fabricating architectural precast concrete units, produce a minimum of 2 sample panels in area for review by Architect. Incorporate full-scale details of architectural features, finishes, textures, and transitions in sample panels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include:
 - 1. Wausau Tile, Inc.
PO Box 1520
Wausau, WI 54402-1520
Phone: (715) 359-3121

Toll Free: (800) 388-8728
Fax: (715) 355-4627
General E-Mail: wtile@wausautile.com
Website: www.wausautile.com

2. Hanover Architectural Products
5000 Hanover Road
Hanover, PA 17331
voice : (717) 637-0500
toll free : (800) 426-4242
fax : (717) 637-7145
email : info@hanoverpavers.com
3. Seaboard Concrete Products
P.O. Box 24001, Richmond, VA 23224
5000 Castlewood Road, Richmond VA 23234
(804) 275-0802 or fax at (804) 271-4763
Email address: contact@seaboardconcrete.com

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from galvanized steel wire into flat sheets.
- D. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- E. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.
- F. Prestressing Strand: ASTM A 416/A 416M, Grade 270 (Grade 1860), uncoated, 7-wire, low-relaxation strand.
 1. Coat unbonded post-tensioning strand with corrosion inhibitor passing ASTM D 1743 and sheath with polypropylene tendon sheathing. Include anchorage devices and coupler assemblies.

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.
 1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
 2. Metakaolin Admixture: ASTM C 618, Class N.
 3. Silica Fume Admixture: ASTM C 1240, with optional chemical and physical requirement.
 4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.
 - a. Gradation: To match design reference sample.
 2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.
- D. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.
- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

2.4 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time.
- C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

2.4 CAULKS AND SEALANTS:

- A. Polyurethane or Acrylic Sealant.
- B. Color to be selected by architect from standard color pallet.

2.5 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
 - 1. Limit use of fly ash and silica fume to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
- D. Normal-Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.
- E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.6 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.
- C. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.
- D. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.
- E. Prestress tendons for architectural precast concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 117.

- F. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- G. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch (25 mm) or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- H. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.
 - 1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- I. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.
 - 1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- J. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.
- K. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.
- L. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- M. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.7 FABRICATION TOLERANCES

- A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

2.8 FINISHES

- A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved sample panels and as follows:
 - 1. As-Cast Surface Finish: Provide surfaces free of pockets, sand streaks, and honeycombs.

- B. Finish exposed surfaces of architectural precast concrete units to match face-surface finish.

2.9 SOURCE QUALITY CONTROL

- A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."
- B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.
- B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.
 - 1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 2. Unless otherwise indicated, provide for uniform joint widths of 3/8 inch.
- C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
- D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
- E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
- F. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
- G. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- B. Field welds will be subject to visual inspections and nondestructive testing according to ASTM E 165 or ASTM E 709. High-strength bolted connections will be subject to inspections.
- C. Testing agency will report test results promptly and in writing to Contractor and Architect.
- D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.3 REPAIRS

- A. Repair damaged architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.
- B. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.
- C. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- D. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.4 CLEANING

- A. Clean surfaces of precast concrete units exposed to view.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 034500

SECTION 057300 - DECORATIVE METAL RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel and iron decorative railings.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.
- C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on laboratory mockups.
 - 1. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
 - 2. Test railings according to ASTM E 894 and ASTM E 935.

1.4 SUBMITTALS

- A. Product Data: For the following:

1. Manufacturer's product lines of railings assembled from standard components.
 2. Grout, anchoring cement, and paint products.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples: For each type of exposed finish required.
- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation.
- E. Qualification Data: For qualified testing agency.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.
- G. Preconstruction test reports.

1.5 QUALITY ASSURANCE

- A. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockups for each form and finish of railing consisting of two posts, top rail, infill area, and anchorage system components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Steel and Iron Decorative Railings:
 - a. Architectural Iron Designs, Inc.
 - b. Artezzi.
 - c. Bavarian Iron Works Co.; TT Triebenbacher.
 - d. Blum, Julius & Co., Inc.
 - e. Braun, J. G., Company; a division of the Wagner Companies.
 - f. Indital USA; a division of Ind.i.a. SPA.
 - g. Lawler Foundry Corporation.
 - h. Livers Bronze Co.
 - i. Olin Wrought Iron.
 - j. Regency Railings.

- k. Wagner, R & B, Inc.; a division of the Wagner Companies.
- l. Wiemann Ironworks.

2.2 METALS, GENERAL

- A. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

2.3 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed).
- B. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.4 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
 - 2. Galvanized-Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating.
 - 3. Dissimilar Metals: Type 304 stainless-steel fasteners.
- B. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

2.5 MISCELLANEOUS MATERIALS

- A. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
- C. Epoxy Intermediate Coat: Complying with MPI#77 and compatible with primer and topcoat.
- D. Polyurethane Topcoat: Complying with MPI#72 and compatible with undercoat.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Connections: Fabricate railings with welded connections unless otherwise indicated.
- C. 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. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- D. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings.
- E. Form changes in direction By bending.
- F. 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.
- G. Close exposed ends of hollow railing members with prefabricated end fittings.
- H. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

2.7 STEEL AND IRON FINISHES

- A. Preparing Nongalvanized Items for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- B. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1.
- C. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1.
 - 1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
 - 2. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- B. Use 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 grout.
- C. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with grout.
- D. Anchor posts to metal surfaces as indicated using fittings designed and engineered for this purpose.
- E. Anchor railing ends to concrete and masonry with flanges connected to railing ends and anchored to wall construction with anchors and bolts.
- F. Attach handrails to walls with wall brackets.
 - 1. Use type of bracket with predrilled hole for exposed bolt anchorage.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- G. Secure wall brackets to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
- H. Glass-Supported Railings: Install assembly to comply with railing manufacturer's written instructions.
- I. Post-Supported Glass Railings: Install assembly to comply with railing manufacturer's written instructions and with requirements in other Part 3 articles. Erect posts and other metal railing components, then set factory-cut glass panels. Do not cut, drill, or alter glass panels in field. Protect edges from damage.
- J. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

END OF SECTION 057300

SECTION 070000 INTENSIVE GREEN ROOF MEDIA

PART 1 – GENERAL

1.0 SUMMARY

- A. Section Includes:
 - 1. Green Roof Planting Media
- B. Related Sections

1.01 REFERENCES

- A. ASTM – American Society for Testing and Materials
 - ASTM E2788-11, ASTM E2397-11, ASTM E2399-11
- B. FLL Guidelines for the Planning, Execution and Upkeep of Green-Roof Sites

1.02 SYSTEM DESCRIPTION

- A. Premixed Intensive Green Roof Media containing the components below:

60% Recycled G Expanded Slate: 20% USGA Root Zone Sand: 15% compost: 5% Pine bark fines

PART 2 – PRODUCTS

2.01 MANUFACTURERS:

- A) EARTH Products, LLC
 - PO Box 3750
 - Peachtree City, GA 30269
 - 1-800-286-6677 Toll-Free
 - (770) 487-3992 Fax
 - sales@erthproducts.com
 - www.erthproducts.com
- B) STALITE Permatill
 - Corporate & Sales Offices
 - PO Box 1037
 - Salisbury, NC 28144
 - 205 Klumac Road
 - Salisbury, NC 28145
 - 800-898-3772
 - www.stalite.com
- C) Norlite, LLC
 - 628 S. Saratoga Street
 - Cohoes, NY 12047
 - (518) 235-0030 (phone)
 - (518) 235-0233 (fax)
 - info@norliteegg.com

2.02 MATERIALS

A. Recycled G Fines from screening operation

Sieve Size	% Retained
#4	20-27%
#8	47-65%
#16	64-78%
#30	75-85%
#50	82-90%
#100	87-95%
Fine Material	2.79-3.53 % passing #200

* Lightweight aggregate shall be certified by an independent testing facility recognized by USGBC verifying the lightweight aggregates meets all qualifications of Pre-consumer 100% recycled waste aggregate content.

B. USGA Root Zone Sand

1. Grain Size Distribution (ASTM C136-95A)

Sieve Size	% Retained on Sieve
2.00 mm	<3%
1-2 mm	10% max
0.5 -1 mm	45% max
.25 -.5 mm	35% - 75%
.15 -.25 mm	15% max
.05 - .15 mm	5% max

C. Organic Component

1. Humus material shall have an ash content of no less than 8 percent and no more than 40 percent.
2. The pH of the organic matter shall be between 5.5 and 7.5
3. The salt content shall be less than 10 millimho/cm at 25 degrees C, (Ece<10) on a saturated paste extract.
4. Types of acceptable composted products can be derived from the following feed stocks: manures, mushroom composts, straw, alfalfa, yard wastes, low in salts, low in heavy metals, free from weed seeds, free of pathogens and other deleterious materials.
5. Composted wood products are conditionally acceptable (stable humus must be present).
6. Sludge-based materials are not acceptable including municipal sewage sludge bio-solids.
7. The organic amendment must have a Carbon/Nitrogen ratio of <25:1.
8. The compost shall be aerobic without malodorous presence of decomposition products.
9. From 75 to 100 percent organic amendment particles shall pass the 4.0 mm sieve size
10. From 45 to 65 percent moisture measured via wet-weight basis.
11. Free of stones, debris, plant material.
15. Organic amendment must test between 5 to 8 on Solvita Maturity Test
16. Metals and contaminants must meet or exceed US EPA Standard 40

2.03 Mixes

A. Intensive Green Roof Media

G Expanded Slate*		60%
USGA Root Zone Sand	20%	
Approved Compost		15%
Pine Bark Fines	5%	

* Registration # SCS-MC-02308 conforming to the SCS Recycled Content Standard.

PART 3 - EXECUTION

3.01 MIXING Procedure

Green Roof Intensive Media is to be mixed by an approved blender only.

A. Compost and USGA Sand Blending

1. Mechanically mix 1 parts sand to 1 parts compost/pine bark fines blend to provide a uniform distribution of the components.
2. Inadequate Moisture Content: Do not work planting medium when moisture content is low that dust will form in the air.
3. Do not work planting medium when the moisture content is high enough that excessive compaction will occur. Aerate planting medium until moisture content is uniformly reduced as necessary to achieve optimum compaction.

B. Final Mixing Of Intensive Media With Expanded Slate

1. Saturate the Expanded Slate blend with water to ensure proper soil distribution.
2. Mechanically mix 2 parts of the sand/compost blend with 3 parts of the wetted Stalite until a uniform distribution of the components is achieved.
3. When stockpiling the finished mix, cover the pile with a plastic tarp to prevent drying out or soil separation from rain.

3.02 MEDIA MIX PLACEMENT

A. Placement

1. Place Green Roof Media with approved equipment and protect all other materials from damage during installation.
2. Pre-settlement: Preset the media by thoroughly watering the entire planting area. For high traffic areas two passes with a vibratory plate compactor for every one foot lift will be satisfactory to stabilize the media.

3. Fill settled low areas with the media and repeat the compaction and filling process until settlement ceases.

3.03 PROTECTION OF SOIL MIXES

A. Contamination and Compaction

1. Do not deliver or place soils in frozen, wet, or muddy conditions. Material should be at or near optimum compaction moisture content as determined by AASHTO T 99 (ASTM D 698). Do not place materials in an excessively moist condition.
2. When stockpiled, protect soils media from absorbing excess water and from erosion at all times. Do not store materials unprotected from large rainfall events. Do not allow excess water to enter site prior to compaction. If water is introduced into the material after stockpiling, allow material to drain or aerate to optimum compaction moisture content.
3. In handling materials, operating tools and equipment, protect the media from compaction by laying down planking or plywood as required for protection.
4. Pressure wash equipment prior to handling media to prevent weed seed contamination.

END OF SECTION

SECTION 321400 - UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick pavers set in bituminous and mortar setting beds.
2. Concrete pavers set in bituminous and mortar setting beds.

1.2 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Test Reports: three copies, showing compliance with specified ASTM requirements.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations
4. Installation methods.

B. Shop Drawings:

1. Layout drawings of each paved area showing the pattern of pavers, indicate pavers requiring cutting, indicate setting bed methods in each area, drainage patterns and drains.

C. Selection samples of full color range.

1.3 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or build on frozen subgrade or setting beds.

B. Weather Limitations for Bituminous Setting Bed: Install bituminous setting bed only when ambient temperature is above 40 deg F (4 deg C) and when base is dry.

C. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and higher.

PART 2 - PRODUCTS

2.1 BRICK PAVERS

- A. Brick Pavers: Light-traffic paving brick; ASTM C 902. Provide brick without frogs or cores in surfaces exposed to view in the completed Work.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include.
 - 2. Thickness: 2-1/4 inches (57 mm).
 - 3. Face Size: 3-5/8 by 7-5/8 inches (92 by 194 mm)
 - 4. Color: Match Existing City of Richmond Standard
- B. Temporary Protective Coating: Precoat exposed surfaces of brick pavers with a continuous film of a temporary protective coating that is compatible with brick, mortar, and grout products.

2.2 CONCRETE PAVERS

- A. Regional Materials: Provide concrete pavers that have been manufactured within 500 miles (800 km) of Project site from aggregates and cement that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- B. Concrete Pavers: Solid interlocking paving units complying with ASTM C 936 and resistant to freezing and thawing when tested according to ASTM C 67, made from normal-weight aggregates.
 - 1. Manufacturers:
 - a. Peacock Pavers
P.O. Box 519 | Atmore, Alabama 36504-0519
Phone (251) 368.2072
Fax (251) 368.5080
Toll-Free 1.800.264.2072
Don Gordon | don@peacockpavers.com
Ann Gordon | ann@peacockpavers.com
 - b. Wausau Tile, Inc.
PO Box 1520
Wausau, WI 54402-1520
Phone: (715) 359-3121
Toll Free: (800) 388-8728
Fax: (715) 355-4627
General E-Mail: wtile@wausautile.com
Website: www.wausautile.com
 - c. Hanover Architectural Products
5000 Hanover Road
Hanover, PA 17331

voice : (717) 637-0500
toll free : (800) 426-4242
fax : (717) 637-7145
email : info@hanoverpavers.com

2. Thickness: 2"
3. Face Size and Shape: 11.75"x11.75" square.
4. Face Size and Shape: 11.75"x23.5" rectangle.
5. Face Size and Shape: 17 5/8" x 17 5/8" square.
6. Face Size and Shape: 23.5" x 35 3/8" rectangle.
7. Color: Multiple shades of tan and cream. Colors to be selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

- A. Cork Joint Filler: Preformed strips complying with ASTM D 1752, Type II.
- B. Compressible Foam Filler: Preformed strips complying with ASTM D 1056, Grade 2A1.

2.4 AGGREGATE SETTING-BED MATERIALS

- A. Graded Aggregate for Base: Sound, crushed stone or gravel complying with requirements in Division 31 Section "Earth Moving" for base course.
- B. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.
- C. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.
- 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. Apparent Opening Size: No. 40 (0.425-mm) sieve, maximum; ASTM D 4751.
 2. Permittivity: 0.5 per second, minimum; ASTM D 4491.
- E. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

2.5 BITUMINOUS SETTING-BED MATERIALS

- A. Primer for Base: ASTM D 2028, cutback asphalt, grade as recommended by unit paver manufacturer.
- B. Fine Aggregate for Setting Bed: ASTM D 1073, No. 2 or No. 3.

- C. Asphalt Cement: ASTM D 3381, Viscosity Grade AC-10 or Grade AC-20.
- D. Neoprene-Modified Asphalt Adhesive: Paving manufacturer's standard adhesive consisting of oxidized asphalt combined with 2 percent neoprene and 10 percent long-fibered mineral fibers containing no asbestos.
- E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 (1.18-mm) sieve and no more than 10 percent passing No. 200 (0.075-mm) sieve.

2.6 MORTAR SETTING-BED MATERIALS

- A. Regional Materials: Provide aggregate, cement, and lime for mortar that has been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- B. Portland Cement: ASTM C 150, Type I or Type II.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Sand: ASTM C 144.
- E. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.
- F. Water: Potable.

2.7 GROUT MATERIALS

- A. Regional Materials: Provide aggregate and cement for grout that has been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site.
- B. Polymer-Modified Tile Grout: ANSI A118.7, sanded.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide product to match existing or comparable product by one of the following:
 - a. Boiardi Products; a QEP company.
 - b. Bostik, Inc.
 - c. C-Cure.
 - d. Custom Building Products.
 - e. Jamo Inc.
 - f. Laticrete International, Inc.
 - g. MAPEI Corporation.
 - h. ProSpec.
 - i. Southern Grouts & Mortars, Inc.
 - j. Summitville Tiles, Inc.
 - k. TEC, Specialty Construction Brands, Inc.

3. Polymer Type: Ethylene-vinyl acetate or acrylic additive in dry, redispersible form; prepackaged with other dry ingredients.
 4. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
- C. Grout Colors: As selected by Architect from manufacturer's full range.
- D. Water: Potable.

2.8 BITUMINOUS SETTING-BED MIX

- A. Mix bituminous setting-bed materials at an asphalt plant in approximate proportion, by weight, of 7 percent asphalt cement to 93 percent fine aggregate unless otherwise indicated. Heat mixture to 300 deg F (149 deg C).

2.9 MORTAR AND GROUT MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions. Discard mortars and grout if they have reached their initial set before being used.
- B. Mortar-Bed Bond Coat: Mix neat cement and water to a creamy consistency.
- C. Portland Cement-Lime Setting-Bed Mortar: Type M complying with ASTM C 270, Proportion Specification.
- D. Latex-Modified, Portland Cement Setting-Bed Mortar: Comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.
- E. Latex-Modified, Portland Cement Bond Coat: Proportion and mix portland cement, aggregate, and liquid latex for bond coat to comply with written instructions of liquid-latex manufacturer.
- F. Packaged Grout Mix: Proportion and mix grout ingredients according to grout manufacturer's written instructions.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- B. Cut unit pavers with motor-driven masonry saw equipment to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible.
1. For concrete pavers, a block splitter may be used.
- C. Joint Pattern: Match and continue existing unit paver joint pattern.

- D. Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged.
 - 1. Provide joint filler at waterproofing that is turned up on vertical surfaces unless otherwise indicated; where unfilled joints are indicated, provide temporary filler or protection until paver installation is complete.
- E. Tolerances: Do not exceed 1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and 1/4 inch in 10 feet (6 mm in 3 m) from level, or indicated slope, for finished surface of paving.
- F. 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 Division 07 Section "Joint Sealants."
- G. Expansion and Control Joints: 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.

3.2 AGGREGATE SETTING-BED APPLICATIONS

- A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 ASTM D 1557 laboratory density.
- B. Place aggregate base, compact by tamping with plate vibrator, and screed to depth indicated.
- C. Place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches (300 mm).
- D. Place leveling course and screed to a thickness of 1 to 1-1/2 inches (25 to 38 mm), taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
- E. Treat leveling course with herbicide to inhibit growth of grass and weeds.
- F. Set pavers with a minimum joint width of 1/16 inch (1.5 mm) and a maximum of 1/8 inch (3 mm), 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 (10 mm) with pieces cut to fit from full-size unit pavers.
- G. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf (16- to 22-kN) compaction force at 80 to 90 Hz.
- H. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

3.3 BITUMINOUS SETTING-BED APPLICATIONS

- A. Apply primer to concrete slab or binder course immediately before placing setting bed.
- B. Prepare for setting-bed placement by locating 3/4-inch- (19-mm-) deep control bars approximately 11 feet (3.3 m) apart and parallel to one another, to serve as guides for striking board. Adjust bars to subgrades required for accurate setting of paving units to finished grades indicated.
- C. Place bituminous setting bed between control bars. Spread mix at a minimum temperature of 250 deg F (121 deg C). Strike setting bed smooth, firm, even, and not less than 3/4 inch (19 mm) thick. Add fresh bituminous material to low, porous spots after each pass of striking board. Carefully fill depressions that remain after removing depth-control bars.
 - 1. Roll setting bed with power roller to a nominal depth of 3/4 inch (19 mm). Adjust thickness as necessary to allow accurate setting of unit pavers to finished grades indicated. Complete rolling before mix temperature cools to 185 deg F (85 deg C).
- D. Apply neoprene-modified asphalt adhesive to cold setting bed by squeegeeing or troweling to a uniform thickness of 1/16 inch (1.6 mm). Proceed with setting of paving units only after adhesive is tacky and surface is dry to touch.
- E. Place pavers carefully by hand in straight courses, maintaining accurate alignment and uniform top surface. Protect newly laid pavers with plywood panels on which workers can stand. If additional leveling of paving is required, and before treating joints, roll paving with power roller.
- F. Joint Treatment: Place unit pavers with hand-tight joints. Fill joints by sweeping sand over paved surface until joints are filled. Remove excess sand after joints are filled.

3.4 MORTAR SETTING-BED APPLICATIONS

- A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch (1.6-mm) thickness for bond coat.
- C. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
- D. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
- E. Wet brick pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. (30 g/194 sq. cm) per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

- F. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform 1/16-inch- (1.5-mm-) thick bond coat to mortar bed or to back of each paver with a flat trowel.
- G. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.
- H. Spaced Joint Widths: Provide 3/8-inch (10-mm) [1/2-inch (13-mm) nominal joint width with variations not exceeding plus or minus 1/16 inch (1.5 mm).
- I. Grouted Joints: Grout paver joints complying with ANSI A108.10.
- J. Grout joints as soon as possible after initial set of setting bed.
 - 1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
 - 2. Tool exposed joints slightly concave when thumbprint hard.
- K. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.
- L. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.
 - 1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.

END OF SECTION 321400

SECTION 328400 - PLANTING IRRIGATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Piping.
 - 2. Manual valves.
 - 3. Automatic control valves.
 - 4. Automatic drain valves.
 - 5. Sprinklers.
 - 6. Quick couplers.
 - 7. Controllers.
 - 8. Boxes for automatic control valves.

1.2 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be automatic operation with controller and automatic control valves.
- B. Location of Sprinklers and Specialties: Irrigation system to be Design-Build. Coordinate new irrigation with existing irrigation system along existing Canal Walk, as maintained by Venture Richmond. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.
- C. Delegated Design: Design 100 percent coverage irrigation system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Available land records indicate the following soil conditions:
 - a. Type: Unknown.
- D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
 - 1. Irrigation Main Piping: 200 psig (1380 kPa).
 - 2. Circuit Piping: 150 psig (1035 kPa).

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.

- C. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Zoning Chart: Show each irrigation zone and its control valve.
- E. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- F. Field quality-control reports.
- G. Operation and maintenance data.

1.4 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.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. See existing canal walk irrigation system for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes. Match existing.

2.2 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 MANUAL VALVES

- A. Curb Valves:

1. Description:
 - a. Match Existing Canal Walk Irrigation.

- B. Curb-Valve Casing:
 1. Standard: Similar to AWWA M44 for cast-iron valve casings.
 2. Top Section: Telescoping, of length required for depth of burial of curb valve.
 3. Barrel: Approximately 3-inch (75-mm) diameter.
 4. Plug: With lettering "WATER."
 5. Bottom Section: With base of size to fit over valve.
 6. Base Support: Concrete collar.

- C. Shutoff Rods for Curb-Valve Casings: Furnish [two] steel, tee-handle shutoff rod(s) with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve for Project.

- D. Brass Ball Valves:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 2. Basis-of-Design Product: Subject to compliance with requirements or comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. KITZ Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.

3. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded or solder joint if indicated.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.

j. Port: Full or regular, but not reduced.

E. Bronze Ball Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. Crane Co.; Crane Valve Group; Crane Valves.
- d. Hammond Valve.
- e. Lance Valves; a division of Advanced Thermal Systems, Inc.
- f. Legend Valve.
- g. Milwaukee Valve Company.
- h. NIBCO INC.
- i. Red-White Valve Corporation.
- j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-110.
- b. SWP Rating: 150 psig (1035 kPa).
- c. CWP Rating: 600 psig (4140 kPa).
- d. Body Design: Two piece.
- e. Body Material: Bronze.
- f. Ends: Threaded or solder joint if indicated.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full[or regular, but not reduced].

F. Iron Ball Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:

- a. American Valve, Inc.
- b. Conbraco Industries, Inc.; Apollo Valves.
- c. KITZ Corporation.
- d. Sure Flow Equipment Inc.
- e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

- a. Standard: MSS SP-72.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Design: Split body.
- d. Body Material: ASTM A 126, gray iron.
- e. Ends: Flanged.
- f. Seats: PTFE or TFE.
- g. Stem: Stainless steel.
- h. Ball: Stainless steel.
- i. Port: Full.

G. Plastic Ball Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Asahi/America, Inc.
 - c. Colonial Engineering, Inc.
 - d. Fischer, George Inc.
 - e. Hayward Flow Control Systems; Hayward Industrial Products, Inc.
 - f. IPEX Inc.
 - g. Jomar International, LTD.
 - h. KBI (King Bros. Industries).
 - i. Legend Valve.
 - j. NIBCO INC.
 - k. Sloane, George Fischer, Inc.
 - l. Spears Manufacturing Company.
 - m. Thermoplastic Valves Inc.
 - n. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating: Match Existing.
 - c. Body Material: PVC.
 - d. Type: Union.
 - e. End Connections: Socket or threaded.
 - f. Port: Full.

H. Iron Gate Valves, Resilient Seated:

1. Description:
 - a. Standard: AWWA C509.
 - b. Pressure Rating: Match existing.
 - c. Body Material: Ductile or gray iron with bronze trim.
 - d. End Connections: Mechanical joint or push-on joint.
 - e. Interior Coating: Comply with AWWA C550.
 - f. Body Design: Nonrising stem.
 - g. Operator: Stem nut.
 - h. Disc: Solid wedge with resilient coating.

I. Iron Gate Valve Casings:

1. Standard: AWWA M44 for cast-iron valve casings.
2. Top Section: Adjustable extension of length required for depth of burial of valve.
3. Barrel: Approximately 5-inch (125-mm) diameter.
4. Plug: With lettering "WATER."
5. Bottom Section: With base of size to fit over valve.
6. Base Support: Concrete collar.

- J. Operating Wrenches for Iron Gate Valve Casings: Furnish two steel, tee-handle operating wrench(es) with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut for Project.

2.4 AUTOMATIC CONTROL VALVES

A. Bronze, Automatic Control Valves:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product to match existing or comparable product by one of the following:
 - a. Buckner; a division of Storm Manufacturing Group Inc.
 - b. Ceres Products Company.
 - c. Champion Irrigation Products.
 - d. Netafim USA.
 - e. Superior Controls Co., Inc.
 - f. Toro Company (The); Irrigation Division.
 - g. Weathermatic.
- 2. Description: Cast-bronze body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

B. Plastic, Automatic Control Valves:

- 1. Basis-of-Design Product: Subject to compliance with requirements, provide product to match existing or comparable product by one of the following:
 - a. Buckner; a division of Storm Manufacturing Group Inc.
 - b. Ceres Products Company.
 - c. Champion Irrigation Products.
 - d. Dig Corporation.
 - e. Greenlawn Sprinkler Company.
 - f. Hit Products Corporation.
 - g. Hunter Industries Incorporated.
 - h. Irritrol Systems.
 - i. Nelson, L. R. Corporation.
 - j. Netafim USA.
 - k. Olson Irrigation Systems.
 - l. Orbit Irrigation Products, Inc.
 - m. Rain Bird Corporation.
 - n. Superior Controls Co., Inc.
 - o. Toro Company (The); Irrigation Division.
 - p. Weathermatic.
- 2. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

2.5 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 (17 to 20 kPa).

2.6 SPRINKLERS

- A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.
- B. Plastic, Exposed, Impact-Drive Rotary Sprinklers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product to match existing or comparable product by one of the following:
 - a. Champion Irrigation Products.
 - b. K-RAIN Manufacturing Corporation.
 - c. Nelson, L. R. Corporation.
 - d. Orbit Irrigation Products, Inc.
 - e. Senninger Irrigation, Inc.
 - 2. Description:
 - a. Construction: ABS and corrosion-resistant metals.
 - b. Mounting: Aboveground, exposed on riser.
 - 3. Capacities and Characteristics:
 - a. TBD
- C. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product to match existing or comparable product by one of the following:
 - a. Buckner; a division of Storm Manufacturing Group Inc.
 - b. Champion Irrigation Products.
 - c. Hunter Industries Incorporated.
 - d. Irritrol Systems.
 - e. K-RAIN Manufacturing Corporation.
 - f. Nelson, L. R. Corporation.
 - g. Rain Bird Corporation.
 - h. Toro Company (The); Irrigation Division.
 - i. Weathermatic.
 - j.
 - 2. Description:
 - a. Body Material: ABS.
 - b. Nozzle: Match existing, as applicable.
 - c. Retraction Spring: Stainless steel.
 - d. Internal Parts: Corrosion resistant.
 - 3. Capacities and Characteristics:
 - a. TBD.
- D. Plastic, Pop-up, Impact-Drive Rotary Sprinklers:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product to match existing or comparable product by one of the following:

- a. Buckner; a division of Storm Manufacturing Group Inc.
- b. Ceres Products Company.
- c. Champion Irrigation Products.
- d. Nelson, L. R. Corporation.
- e. Toro Company (The); Irrigation Division.

2. Description:

- a. Case: ABS.
- b. Pop-up Height: Approximately 3 inches (75 mm).
- c. Sprinkler Construction: ABS and other corrosion-resistant metals.

3. Capacities and Characteristics:

- a. TBD.

E. Plastic, Surface Spray Sprinklers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product to match existing or comparable product by one of the following:

- a. Ceres Products Company.
- b. Champion Irrigation Products.
- c. Hit Products Corporation.

2. Description:

- a. Body Material and Flange: ABS.
- b. Pattern: Fixed, with flow adjustment.

3. Capacities and Characteristics:

- a. TBD.

F. Plastic, Surface, Pop-up Spray Sprinklers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product to match existing or comparable product by one of the following:

- a. Ceres Products Company.
- b. Champion Irrigation Products.
- c. Hit Products Corporation.

2. Description:

- a. Body Material and Flange: ABS.
- b. Pattern: Fixed, with flow adjustment.

3. Capacities and Characteristics:

- a. TBD.

G. Plastic, Pop-up Spray Sprinklers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product to match existing or comparable product by one of the following:

- a. Buckner; a division of Storm Manufacturing Group Inc.
- b. Ceres Products Company.
- c. Champion Irrigation Products.
- d. Hit Products Corporation.
- e. Hunter Industries Incorporated.
- f. K-RAIN Manufacturing Corporation.
- g. Nelson, L. R. Corporation.
- h. Orbit Irrigation Products, Inc.
- i. Rain Bird Corporation.
- j. Toro Company (The); Irrigation Division.
- k. Weathermatic.

2. Description:

- a. Body Material: ABS.
- b. Nozzle: Match existing, as applicable.
- c. Retraction Spring: Stainless steel.
- d. Internal Parts: Corrosion resistant.
- e. Pattern: Fixed, with flow adjustment.

3. Capacities and Characteristics:

- a. TBD.

H. Plastic Shrub Sprinklers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide product to match existing or comparable product by one of the following:

- a. Buckner; a division of Storm Manufacturing Group Inc.
- b. Ceres Products Company.
- c. Champion Irrigation Products.
- d. Dig Corporation.
- e. Hunter Industries Incorporated.
- f. Orbit Irrigation Products, Inc.
- g. Senninger Irrigation, Inc.
- h. Toro Company (The); Irrigation Division.
- i. Weathermatic.

2. Description:

- a. Body Material: ABS or other plastic.
- b. Pattern: Fixed, with flow adjustment.

3. Capacities and Characteristics:

- a. TBD.

2.7 QUICK COUPLERS

- A. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.
1. Locking-Top Option: Vandal-resistant locking feature. Include two matching key(s).

2.8 CONTROLLERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product to match existing or comparable product by one of the following:
1. Buckner; a division of Storm Manufacturing Group Inc.
 2. Champion Irrigation Products.
 3. Hit Products Corporation.
 4. Hunter Industries Incorporated.
 5. Irritrol Systems.
 6. K-RAIN Manufacturing Corporation.
 7. Nelson, L. R. Corporation.
 8. Netafim USA.
 9. Orbit Irrigation Products, Inc.
 10. Rain Bird Corporation.
 11. Superior Controls Co., Inc.
 12. Toro Company (The); Irrigation Division.
 13. Weathermatic.
- B. Description:
1. Controller Stations for Automatic Control Valves: Each station is variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each station.
 2. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and [two] matching keys; include provision for grounding.
 - a. Body Material: Stainless-steel sheet metal.
 - b. Mounting: Freestanding type for concrete base or Surface type for wall.
 3. Control Transformer: 24-V secondary, with primary fuse.
 4. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
 - a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
 - b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
 - c. Surge Protection: Metal-oxide-varistor type on each station and primary power.
 5. Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.

6. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
 - a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
 - b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
 - c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.
7. Concrete Base: Reinforced precast concrete not less than 36 by 24 by 4 inches (900 by 600 by 100 mm) thick, and 6 inches (150 mm) greater in each direction than overall dimensions of controller. Include opening for wiring.

2.9 BOXES FOR AUTOMATIC CONTROL VALVES

A. Plastic Boxes:

1. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
 - a. Size: As required for valves and service.
 - b. Shape: Match existing.
 - c. Sidewall Material: Match existing.
 - d. Cover Material: Match existing.
 - 1) Lettering: "IRRIGATION"

- ### B. Drainage Backfill: Cleaned gravel or crushed stone, graded from 3/4 inch (19 mm) minimum to 3 inches (75 mm) maximum.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."
- B. Install warning tape directly above pressure piping, 12 inches (300 mm) below finished grades, except 6 inches (150 mm) below subgrade under pavement and slabs.
- C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from 3/4 to 3 inches (19 to 75 mm), to 12 inches (300 mm) below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Main Piping: Minimum depth of 36 inches (900 mm) below finished grade, or not less than 18 inches (450 mm) below average local frost depth, whichever is deeper.
2. Circuit Piping: 12 inches (300 mm).
3. Drain Piping: 12 inches (300 mm).
4. Sleeves: 24 inches (600 mm).

3.2 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with NPS 2 (DN 50) or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with NPS 2-1/2 (DN 65) or larger pipe connection.
- H. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.
- I. Install expansion loops in control-valve boxes for plastic piping.
- J. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- K. Install ductile-iron piping according to AWWA C600.
- L. Install PVC piping in dry weather when temperature is above 40 deg F (5 deg C). Allow joints to cure at least 24 hours at temperatures above 40 deg F (5 deg C) before testing.

3.3 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- E. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.
- F. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
- G. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- H. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.
- I. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

3.4 VALVE INSTALLATION

- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
 1. Install valves and PVC pipe with restrained, gasketed joints.
- C. Aboveground Valves: Install as components of connected piping system.
- D. Throttling Valves: Install in underground piping in boxes for automatic control valves.
- E. Drain Valves: Install in underground piping in boxes for automatic control valves.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.

- C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches (100 mm) from walls and 2 inches (50 mm) from other boundaries unless otherwise indicated.

3.6 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases.
 - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Install control cable in same trench as irrigation piping and at least 2 inches (51 mm) below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

3.7 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
 - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Division 31 Section "Earth Moving" for warning tapes.

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Any irrigation product will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.9 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch (13 mm) above, finish grade.

3.10 PIPING SCHEDULE

- A. Install components having pressure rating equal to or greater than system operating pressure.
- B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.
- C. Aboveground irrigation main piping, NPS 4 (DN 100) and smaller, shall be one of the following:
 - 1. Match existing Canal Walk irrigation system.
- D. Underground irrigation main piping, NPS 4 (DN 100) and smaller, shall be one of the following:
 - 1. Match existing Canal Walk irrigation system.
- E. Circuit piping shall be one of the following:
 - 1. Match existing Canal Walk irrigation system.
- F. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.
 - 1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.
 - 1. Risers to Aboveground Sprinklers and Specialties: Match existing Canal Walk irrigation system.
- G. Risers to Aboveground Sprinklers and Specialties: Schedule 80, PVC pipe and socket fittings; and solvent-cemented joints.
- H. Drain piping shall be one of the following:
 - 1. SDR 9, 11.5, or 15, PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.
 - 2. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
 - 3. SDR 21, 26, or 32.5, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

3.11 VALVE SCHEDULE

- A. Underground, Shutoff-Duty Valves: Use the following:

1. Match existing.
- B. Aboveground, Shutoff-Duty Valves:
1. Match existing.
- C. Throttling-Duty Valves:
1. Match existing.
- D. Drain Valves:
1. Match existing.

END OF SECTION 328400

SECTION 329300 - PLANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plants.
 - 2. Planting soils.

1.2 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.
- C. Finish Grade: Elevation of finished surface of planting soil.
- D. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- E. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- F. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- G. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- H. 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.
- I. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- J. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

- K. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- L. Structural Soil: See drawings for definition.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated, including soils.
- B. Samples of mineral mulch.
- C. Product certificates.
- D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year.

1.4 QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 - 1. Pesticide Applicator: State licensed, commercial.
- B. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory.
 - 1. The soil-testing laboratory shall oversee soil sampling.
 - 2. Report suitability of tested soil for plant growth.
 - a. State recommendations for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
 - b. Report presence of problem salts, minerals, or heavy metals; if present, provide additional recommendations for corrective action.
- C. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- D. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver bare-root stock plants freshly dug. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.
- B. 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.

- C. Handle planting stock by root ball.
- D. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.
- E. 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.

1.6 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - 2. Warranty Periods from Date of Substantial Completion:
 - a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
 - b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
 - c. Annuals: Three months.

1.7 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established but for not less than maintenance period below.
 - 1. Maintenance Period for Trees and Shrubs: Three months from date of Substantial Completion.
 - 2. Maintenance Period for Ground Cover and Other Plants: Three months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown 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.
- B. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- C. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
 - 1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through No. 60 (0.25-mm) sieve.
 - 2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through No. 60 (0.25-mm) sieve.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent sulfur, with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Aluminum Sulfate: Commercial grade, unadulterated.
- E. Perlite: Horticultural perlite, soil amendment grade.
- F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30-mm) sieve.
- G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.
- H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.
- I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.3 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch (25-mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent.
- D. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

- A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.
- B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.
- C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
- D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
- E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
 - 1. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.5 PLANTING SOILS

- A. Planting Soil: ASTM D 5268 topsoil, with pH range of 5.5 to 7, a minimum of 2 percent organic material content. Verify suitability of soil to produce viable planting soil. Clean soil of roots, plants, sod, stones, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.

2.6 MULCHES

- A. Organic Mulch: Shredded hardwood.

2.7 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. (101g/sq. m) minimum.
- B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 oz./sq. yd. (162 g/sq. m).

2.8 PESTICIDES

- A. General: Pesticide registered and approved by 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.

PART 3 - EXECUTION

3.1 PLANTING AREA ESTABLISHMENT

- A. Loosen subgrade of planting areas to a minimum depth of 12 inches (300 mm). Remove stones larger than 2 inches (50 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply superphosphate fertilizer directly to subgrade before loosening.
 - 2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.
 - 3. Spread planting soil to a depth of 4 inches (100 mm) but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.2 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. 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.
 - 1. Excavate approximately three times as wide as ball diameter.
 - 2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 - 3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
- B. Subsoil and topsoil removed from excavations may not be used as planting soil.

3.3 TREE, SHRUB, AND VINE PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.
- B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Set stock plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.
 - 1. Use planting soil for backfill.
 - 2. Balled and Burlapped: 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. Balled and Potted or Container-Grown: Carefully remove root ball from container without damaging root ball or plant.
 - 4. Fabric Bag-Grown Stock: Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 5. 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.
 - 6. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
 - 7. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. Bare-Root Stock: Set and support bare-root stock in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grade.
 - 1. Use planting soil for backfill.

2. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots.
 3. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside soil-covered roots about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole or touching the roots.
 4. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. 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.

3.4 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 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.

3.5 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.6 PLANTING AREA MULCHING

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches (150 mm) and secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Tree-like Shrubs in Turf Areas: Apply organic mulch ring of 2-inch (50-mm) average thickness, with 36-inch (900-mm) radius around trunks or stems. Do not place mulch within 3 inches (75 mm) of trunks or stems.
2. Organic Mulch in Planting Areas: Apply 2-inch (50-mm) average thickness of mulch extending 12 inches (300 mm) beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches (75 mm) of trunks or stems.

3.7 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.
- 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 practices to minimize the use of pesticides and reduce hazards.
- D. Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- E. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION 329300

VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
SEALING EXPANSION JOINTS

June 14, 2000c
Reissued July 2008c

I. DESCRIPTION

This work shall consist of cleaning and sealing expansion joints in accordance with the contract documents and as directed by the Engineer.

II. MATERIALS

Expansion joint filler and sealer materials shall conform to the requirements of Section 212 of the Specifications.

III. PROCEDURES

Expansion joints shall be cleaned and shall be free of oil, grease, existing joint material or any other foreign material. Loose material shall be removed from the joint with oil-free compressed air delivered with not less than 120 cubic feet of air per minute and a nozzle pressure of not less than 90 pounds per square inch and not more than 200 pounds per square inch.

The Contractor shall protect the edges of pavement adjacent to the joints to be cleaned.

The Contractor shall install joint filler and sealer materials in strict accordance with the manufacturer's written instructions.

Expansion joints shall be filled and sealed in accordance with the requirements of Section 404.05 of the Specifications. Joints to be filled shall be completely dry and the ambient air temperature shall be at least 45 degrees F. The applied sealer and finished joint shall be free of entrapped air. Finished sealer shall conform to the lines and grades of existing pavement surfaces.

VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
ELASTIC INCLUSION - EPS

June 24, 2003a
Revised August 22, 2014

I. DESCRIPTION

Elastic Inclusion work shall consist of installation of an elasticized Expanded Polystyrene (EPS) and geotextile separation fabric between concrete surfaces and backfill material, in accordance with these specifications and in conformity with manufacturer's recommendations, the lines shown on the plans or as established by the Engineer.

II. MATERIALS

- (a) **Elasticized Expanded Polystyrene (EPS):** EPS shall have a size tolerance of 1/8 inch for each dimension and conform to the following:

Physical Property	Test Method	Requirements
Compressive strength	D-1621	720 psf +/-60 psf @10% strain
Water absorption	C-272	Max. 3% by volume
Insect Resistance	D-3345-74	Resistance to ants, termites, etc.

The EPS shall be elasticized, with a linear-elastic stress-strain behavior up to 10 percent strain and linear proportional stress-strain behavior up to 30 percent strain.

The EPS shall contain no chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs) or formaldehyde. It shall be chemically and biologically inert when in contact with acidic and alkaline soils. It shall be treated to prevent insect attack.

Materials shall withstand temperature variations from 0°F to 140°F without deforming and shall maintain their original dimensions and placement without chipping, spalling, or cracking. Material shall not deteriorate because of contact with sodium chloride, calcium chloride, mild alkalis and acids, or other ice control materials.

The EPS shall contain a flame retardant additive.

- (b) **Geotextile Separation Fabric:** A non-woven geotextile separation fabric shall be placed between the EPS and the backfill material. Fabric joints shall have a minimum overlap of twelve inches. Fabric shall extend a minimum of twelve inches beyond the EPS surface and overlap with adjacent concrete surface.

The separation fabric shall have the following properties:

Physical Property	Test Method	Requirements
Grab Strength	D-4632	Min. 250 lb
Puncture Strength	D-4833	Min. 112 lb
Tear Strength	D-4533	Min. 90 lb
Permittivity	D-4491	Min. 0.5 sec ⁻¹
Apparent Opening Size	D-4751	Max. No. 50 sieve

Geotextile separation fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot, insects, and rodents; and biologically and thermally stable.

Geotextile separation fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours during installation.

Tensile strength requirements are in the machine and cross-machine directions.

- (c) **Adhesive:** Adhesive shall be used to bond the EPS to concrete surfaces and the separation fabric to the EPS. It shall be applied in accordance with the EPS manufacturer's recommendations.
- (d) **Backfill Material:** Backfill material adjacent to the separation fabric shall be as specified in the contract documents.

III. PROCEDURES

(a) **Installation of Material:**

The separation fabric may be installed after the EPS has been installed or it may be pre-attached to the EPS. The separation fabric shall cover all exposed surfaces of the EPS.

EPS and separation fabric shall be installed in accordance with the manufacturer's recommendations.

IV. TESTING

Elasticized EPS shall be tested by an independent commercial laboratory, to verify the material requirements specified herein. The Contractor shall provide written documentation of all tests specified. Documentation shall include style, lot, roll numbers, and actual results of each test. In addition, the name, address, phone number of the testing laboratory, and date of testing shall be provided.

Geotextile separation fabric shall be tested by an independent commercial laboratory, to verify the material requirements specified herein. The Contractor shall provide written documentation of all tests specified. Documentation shall include style, lot, roll numbers, and actual results of each test. In addition, the name, address, phone number of the testing laboratory, and date of testing shall be provided.

After the EPS has been installed and before the work has been accepted, the Contractor and Inspector shall perform a visual inspection of EPS coverage. Any area deemed unacceptable and questionable as to remaining in position during the placement of the backfill material shall be replaced or repaired, as required.

REPAIR OF FAILED AREA OF EPS: Unacceptable portion of the EPS shall be removed and the concrete surface shall be prepared and the EPS installed in accordance with this special provision. New EPS in the repair areas shall be visually inspected after curing.

SPECIAL PROVISION FOR WATERPROOFING

Description

This work shall consist of furnishing and applying waterproofing material on concrete bridge decks or other surfaces as shown on the plans.

Materials

- (a) **Epoxy-resin compounds and aggregates for surface application** shall conform to the requirements of Section 243. Epoxy resin shall be Type EP-5, low viscosity for concrete bridge deck applications and Type EP-3B/EP-3T for concrete beam ends and concrete substructure seat applications.
- (b) **Membrane and primer** shall conform to the requirements of Section 213.

416.03—Procedures

- (a) **Epoxy-resin:** Containers, tools, and mechanical equipment shall be free from solvents, loose material, and deposits of hardened material.

Epoxy resin shall not be applied when the concrete surface or the ambient air temperature is below 50 degrees F unless otherwise permitted by the manufacturer's instructions.

1. **Surface preparation:** Surfaces on which epoxy compounds are to be applied shall be free from grease, dirt, dust, paint, mill scale, curing compound, laitance, and other foreign material.

Concrete surfaces on which epoxy compounds are to be used shall be sandblasted sufficiently to expose the sound concrete. Surfaces that are not to receive epoxy compounds shall be protected from sandblasting. Immediately following sandblasting, the surface shall be thoroughly cleaned.

Before epoxy compounds are applied to metal surfaces, surfaces shall be sandblasted to a bright metallic luster.

Wood surfaces shall be sanded to the texture of new wood.

2. **Mixing:** Epoxy mortar shall be made by blending sand, epoxy resin, and hardener in accordance with the manufacturer's instructions.

Batch sizes shall be limited to the maximum batch size recommended by the manufacturer. Mixed epoxy compounds shall be used within the manufacturer's specified pot life. Solvents or other materials shall not be added to the mixture.

3. **Application:** Masking shall be used to form straight edges. Epoxy resin shall not be allowed to flow into or over expansion joints. The first coat of epoxy resin shall be applied at the rate of 1 gallon per 75 square feet. Sand shall be broadcast into the wet epoxy in sufficient quantity, approximately 11 pounds per square yard, to cover the epoxy completely. Sand shall be firmly

embedded so that at least 95 percent of the deck area displays a sand surface after brooming. Brooming shall not be performed until the epoxy resin has cured sufficiently to prevent tearing. After curing, unbonded sand shall be broomed from the surface and may be reused if uncontaminated. The second coat of epoxy resin shall be applied at the rate of 1 gallon of epoxy per 50 square feet. Requirements pertaining to masking, epoxy, flow, sand broadcasting, percentage of embedment, curing, and brooming shall also apply to the second coat of epoxy resin. Applications of Epoxy Type EP-3B/EP-3T for concrete beam ends and concrete substructure seat applications will not require sand to be broadcast into the material.

At edges of the waterproofing system and at any point where it is punctured by appurtenances such as drains or pipes, suitable provisions shall be made to prevent water from getting between the waterproofing and the waterproofed surface.

4. **Curing:** Curing time shall conform to the manufacturer's recommendations. During this time, both pedestrian and vehicular traffic shall be barred from freshly placed surfaces.

(b) **Membrane:**

1. **Waterproofing membrane system. Section 213 of the current VDOT Specifications states that "Membrane shall conform to the requirements of ASTM D6153". ASTM Standard D6153 contains the following requirements for physical properties of membranes:**
 - Permeability shall be determined in accordance with Test Method **E96/E96M** water method.
 - Pliability shall be determined in accordance with Test Method **D146**, except that the test temperature of the test specimen shall be -18°C after 24 h and 180° bend over a 6-mm (1/4-in.) mandrel.

The system shall consist of one of the following systems in accordance with the requirements of ASTM Standard D6153:

Type I – Cold applied elastomeric. Type I covers cold liquid applied chemically curing membrane materials which prevent the passage of water from the asphalt surface course to or through the bridge deck. A membrane protection course as specified by the membrane manufacturer is required.

Type III – Preformed sheet membrane. Type III covers preformed membrane systems which prevent the passage of water from the asphalt surface course to or through the bridge deck.

The type of system to be used will be as specified on the plans.

2. **Construction:** On new decks, the waterproofing membrane system shall not be placed until at least 28 days after deck concrete placement unless otherwise directed by the Engineer.

Each phase of the bridge deck construction shall be completed, including the placing of the surface course overlay, before traffic may be placed on that portion of the bridge structure. In order to minimize possible damage to the membrane, exposure of the membrane shall be minimized. Only vehicles necessary for construction will be permitted on the structure during and after the placing of the membrane system, and such vehicles shall be rubber tired or have rubber-covered treads. The Contractor shall be responsible for maintaining the condition of the membrane system throughout construction.

All methods employed in performing the work and equipment, tools, and machinery used for handling materials and executing any part of the work shall be subject to the approval of the Engineer before the work is started, and whenever found unsatisfactory, they shall be changed and improved as required. Equipment, tools, machinery, and containers used shall be kept clean and maintained in satisfactory working condition.

The Contractor shall furnish the services of a competent field representative of the approved manufacturer to be present at the work site prior to any use of materials. The representative shall instruct the Contractor and the Engineer on installation and inspection procedures and to inspect the condition of the prepared surfaces. The representative will remain on the job site until the completion of the work.

Work shall not be performed during wet weather conditions. In addition, work shall not be performed when the deck and ambient air temperatures are below manufacturer's limits + 5 degrees F. The deck surface shall be thoroughly dry at the time of the application of the primer or liquid membrane.

Concrete parapet surfaces and railing, including armor plates for the joint seals, shall be protected to prevent their being defaced by primer or membrane material. Should defacement occur, the Contractor shall clean surfaces on the structure to the satisfaction of the Engineer.

Between the time the bridge deck is cleaned and prepared for primer and the time the membrane system is placed, no vehicles shall be operated on the area being treated. Only the necessary personnel and equipment to perform the required work will be allowed on the treated surface, and only at such time and in such manner as approved by the Engineer. Care shall be taken to prevent sudden starts, stops, or turns by equipment. All other traffic shall be maintained on portions of the structure that are not being given the membrane protection.

3. **Preparation of concrete deck:** Surfaces that are to be covered shall be thoroughly cleaned by the use of shot blasting, followed by the use of air jets, mechanical sweepers, hand brooms, or other approved methods, or as required by the Engineer, until the surface is free of sand, clay, dust, and loose or foreign matter. Water shall not be used to clean the deck unless authorized by the Engineer.

Any accumulations of oil or grease shall be scraped off of the surface and cleaned with a strong caustic solution. The resulting residue shall be thoroughly flushed away with clean water. Cleaned areas shall be primed without delay as soon as they are dry. Dust and dirt shall be blown off with air jets immediately preceding application of primer or liquid membrane.

Any sharp concrete protrusions on the deck surface that would puncture the membrane shall be removed prior to application of the membrane.

4. **Construction procedures:**

Type I Membrane System

Testing - Random tests for adequate tensile bond strength shall be conducted on the substrate by the applicator on site using an Elcometer Adhesion Tester Model 106 or similar at a minimum frequency of three tests per 5,000 square feet. Smaller areas shall

receive a minimum of three tests. Should the tensile bond strengths be lower than 100 psi on concrete (or failure within the concrete) or 290 psi on steel, the Engineer may request further surface preparation.

Application - Application can proceed while air and substrate temperature are between 32°F and 104°F providing the substrate is *above* the dew point. Outside these temperatures the manufacturer shall be consulted. All components of the system shall be measured and mixed strictly in accordance with the manufacturer's recommendations. Mixing shall be done with either an air driven high speed paddle or an explosion proof mixer. Prior to the application of any materials, the surface must be clean and free from loose debris, moisture, oil, grease or other contaminants.

1. Primer. A single coat of spray, roller or brush applied primer is required for all steel and concrete surfaces. This primer shall cure tack free before application of the waterproofing membrane.
2. Membrane. The waterproofing membrane shall be spray applied with suitable equipment approved by the manufacturer, in two color differentiated coats, each with a wet film thickness of 60 mils per coat providing a finished minimum thickness of 80 mils on any peak. Checks for wet film thickness shall be carried out typically every 100 square feet. The membrane shall cure between coats and before application of the tack coat.
3. Tack Coat. A tack coat, supplied by the same manufacturer, shall be applied directly to the waterproofing membrane prior to surfacing.

Repairs:

1. Patching. If an area is left untreated or the membrane becomes damaged, a patch repair shall be carried out to restore the integrity of the system. The damaged area shall be cut back to sound material and wiped with solvent (e.g., acetone) up to a width of at least 4 inches on the periphery, removing tack coat and any contaminants. The substrate shall be primed, if necessary, followed by the application of membrane. A continuous layer shall be obtained over the substrate with a 4-inch overlap onto the existing membrane.
2. Overlapping. Where the membrane is to be joined to existing cured material and at day joints, the new application shall overlap the existing one by at least 4 inches. No preparation shall be necessary unless the existing materials are contaminated with tack coat or dirt in which case the repair/overlap area shall first be wiped with solvent (e.g., acetone).

Protection - During all stages of application, the membrane shall be protected by the Contractor from damage by construction operations.

Final Review - The Engineer and the applicator shall jointly review the deck area(s) in which the completed system has been installed, prior to surfacing. Any irregularities or other items which do not meet the requirements of the Engineer shall be addressed at this time.

Type III Membrane System

Application - A prime coat shall be applied to areas that will be covered with membrane within the following 24 hours. Any areas not covered within 24 hours must be re-primed. The primer material and rate of coverage shall meet the specifications of the manufacturer. The primer shall be allowed to dry one hour or until tack free before placing the membrane. The membrane shall not be applied at temperatures below 40°F.

All corners such as at curbs shall be double covered by using an initial strip of 12-inch minimum width, placed along the axis of the corner. Inside corners should be finished with a fillet, and outside corners should be rounded. Areas around drains or other protrusions should be double covered with the membrane for a minimum of 6 inches in each direction then liberally coated with an approved mastic.

Before applying the membrane, the direction of operation of the paving equipment shall be ascertained. Unless otherwise approved, each phase of Type III membrane construction shall begin at the low point of the surface to be waterproofed and shingled so that water will run over and not against any laps. . At deck joints, the membrane shall extend to the edge of the joint opening as shown on the plans.

Type III membrane shall be applied to the primed curb and bridge deck surfaces by either hand methods or mechanical applicators. Type III membranes shall be placed in such a manner that a shingling effect will be achieved, and any water that accumulates will drain toward the curb and the drainpipes. Each strip shall be overlapped a minimum of 4 inches. The membrane sections shall be placed so that end laps will be in the direction of the paving operation.

An adhesive or a wide tipped torch shall be used, if necessary, to ensure a good seal of the membrane joints. Hand rollers or other satisfactory pressure apparatus shall be used on the applied membrane to ensure firm and uniform contact with the primed concrete surfaces. Special care shall be used at the curb face to ensure that the membrane is uniformly and positively adhering to the concrete.

Type III membranes shall be free of wrinkles, air bubbles, and other placement defects. Any torn or cut areas or narrow overlaps shall be patched using a satisfactory adhesive and by placing sections of the membrane over the defective area in such a manner that the patch extends at least 6 inches beyond the defect. The patch shall be rolled or firmly pressed onto the surface.

5. Material Requirements:

Type I Membrane System

- a. Primer shall be a 100-percent solvent-free reactive, acrylic-based, two-component resin.
- b. Membrane shall consist of an acrylic resin based two coat, 100 percent solvent-free reactive, two-component elastomeric membrane. Each coat shall be 60 mils (1.5 mm) thick and differentially pigmented for quality control. In addition the membrane shall meet or exceed the following properties, backed by a certificate of conformity, as related to laboratory prepared samples tested at 68°F (20°C) and a 24-hour cure, where applicable.

Test	Method	Required Results
Cure Time	/A	30 Minutes
Water Vapor Transmission	ASTM E96	0.026 gr/tt'/hr (0.18 g/m' /hr)
Adhesion to Concrete	ASTM D4541	100 psi (0.7 MPa)
Adhesion to Steel	ASTM D4541	290 psi (2.0 MPa)
Tensile Strength	ASTM D638, Method A, Die C	435 psi (3.0 MPa)
Min. Elongation at break	ASTM D638, Method A, Die C	100%
Low Temperature	1/4" (6.35 mm) mandrel @-13°F (-25°C)	Pass
Crack Bridging	ASTM C836	Pass @ 25 cycles, 0.0625 in, -15° F 1.6 mm, -26° C

Type III Membrane System

The waterproofing membrane shall be provided in rolled sheet form. One face of the membrane shall be adhesive and protected with an easily removable coated backing paper to prevent adhesion of the membrane to itself. The membrane shall be composed of rubberized or polymer modified asphalt, reinforced with a fiberglass or polypropylene mesh.

- a. Primer shall either conform to ASTM 041 or be as specified by the membrane manufacturer.
- b. Sheet Membrane shall conform to the following specifications.

Test	Method	Required
Thickness	-	60 mils (+/- 5 mils)
Tensile Strength	Per ASTM D882	50 lbs/in. (88 N/cm) 25% elongation, min
Pliability	Per ASTM D146 At -15°F (-26° C) with 1" (25.4 mm) mandrel	No cracks or splits
Puncture Resistance	ASTM E154	200 lbs. (890 N) min.
Permeance	ASTM E96	0.1 perms (.066 m perms). max.

SPECIAL PROVISION FOR PREFORMED ELASTOMERIC JOINT SEALER MODIFIED

I. DESCRIPTION

This work shall consist of furnishing and installing a structural sealing expansion joint system, of the width specified in the contract, designed to withstand 100% of the movement range specified in the contract without modifying the proposed joint width. The system shall also withstand the effects of vertical and lateral movements, with no adhesive or cohesive failure, maintaining water tightness at the same time. The joint sealer shall be bonded in place with epoxy and inflated until epoxy is cured.

II. MATERIALS

- A.** Materials for preformed elastomeric joint sealer modified shall conform to the requirements of Section 212 of the specifications.
- B.** The adhesive shall be a double component, epoxy based adhesive, which shall be mixed at the job site. It shall have the following properties:

Two component thixotropic paste	ASTM C-881 Type V Class B and C.
Tensile strength, ASTM D638	4140 psi
Compression strength, ASTM D-695	8760 psi
Solids hardness	5 MOHS
Pot life	40 min. @ 68°F
Flash point	Greater than 200F
Curing time/strong bond within	24 Hours
Complete cure	7 days @ 68°F

III. CONSTRUCTION METHODS

- A.** Safety Provisions:

Personnel shall be thoroughly trained in the safe handling of materials in accordance with the Manufacturer's recommendations.

- B.** Storage of Materials:

Materials shall be stored in accordance with the manufacturer's recommendations.

- C.** Joint Preparation:

The joint shall be thoroughly cleaned by disk grinding, sandblasting, or as approved by the Engineer so that it is free from dust, oil, grease, or other foreign materials.

- D.** Installation:

Prefomed elastomeric joint sealer modified shall be installed in accordance with the manufacturer's recommendations and under the supervision of a manufacturer certified technician. The top surface after installation shall be 1/8 inch below the surface of the bridge deck.

SPECIAL PROVISION FOR DRAINAGE BOARD

PART 1 - GENERAL

SUMMARY

- A. Section includes:
 - 1. Drainage system material at horizontal waterproofed plaza slabs or planters as complete designed working drainage system channeling liquid water to drainage piping system specified elsewhere.
- B. Related Special Provisions:
 - 1. Waterproofing

REFERENCES

- A. Standards of the following as referenced:
 - 1. American Society for Testing and Materials (ASTM).

DEFINITIONS

- A. Terms 1 through 4 taken from ASTM D4439:
 - 1. Geotextile: Any permeable textile used with foundation, soil, rock, earth, or any other geotechnical material, as an integral part of man-made product, structure, or system.
 - 2. Normal direction: Direction perpendicular to the plane of a geotextile.
 - 3. Permittivity: Volumetric flow rate of water per unit cross sectional area per unit head under laminar flow conditions, in the normal direction through a geotextile.
 - 4. Permeability: Rate of flow of a liquid under a differential pressure through a material.
 - 5. Transmissivity: Flow or amount of liquid water per foot of material width passing through composite system at certain maximum soil pressure against geotextile at defined hydraulic gradient.

SYSTEM DESCRIPTION

- A. Performance requirements:
 - 1. Geotextile:
 - a. UV resistance: 70% or more when tested in accord with ASTM D4355-02.
 - b. Permittivity: 150 gal/min/ft² (6105 l/min/m²) when tested in accord with ASTM D4491-03.
 - 2. Core material, compressive strength: Specified in PART 2 - PRODUCTS Article below for selected materials.
 - 3. Transmissivity or Flow Q with hydraulic gradient of 1 with confining stress indicated in MANUFACTURED UNITS Article in accord with ASTM D4716-04.

SUBMITTALS

- A. Product data: Manufacturer's product data; indicate products supplied. Provide complete installation instructions proposed for use.
- B. Samples:
 - 1. Subdrainage system material: 4" by 4".

QUALITY ASSURANCE

- A. Preinstallation conferences: Coordinate with conference scheduled for waterproofing materials. Follow requirements indicated in Special Provision for Waterproofing.

DELIVERY, STORAGE, AND HANDLING

- A. Packing and shipping: Provide materials in original unopened containers with manufacturer's labels intact and legible.
- B. Acceptance at site:
 - 1. Unload materials: check for damage.
 - 2. Damaged materials determined by visual inspection will not be accepted.
 - 3. Remove rejected materials from site immediately.
- C. Storage and protection:
 - 1. Store materials in dry area in manufacturer's protective packaging in original containers with labels and installation instructions intact.
 - 2. Store materials under cover, off ground; protect from sunlight.

SEQUENCING AND SCHEDULING

- A. Schedule drainage material installation on horizontal surfaces after waterproofing installation and curing and just prior to installation of cover material.

PART 2 - PRODUCTS

MANUFACTURED UNITS

- A. Acceptable manufacturers:
 - 1. Products specified as standard of quality are manufactured by:
 - Sika Corporation; Sika Drainage Mat 1000.**
201 Polito Avenue
Lyndhurst, New Jersey 07071.
Telephone: 800.933.7452 Fax: 201.933.6225.
Website: www.sikausa.com
 - JDR Enterprises, Inc.; J-DRain 1000**
292 South Main Street Suite 200
Alpharetta, Georgia 30004.
Telephone: 800.843.7569 or 770.442.1461. Fax: 770.664.7951.
Website: www.j-drain.com
 - Tremco; WaterDrain 302**
3735 Green Road
Beachwood, Ohio 44122
Telephone: 216.292.5000.
Website: www.tremcoroofing.com
 - 2. Approved equal.
- B. Performance Requirements
 - Geonet Drainage System material**, characteristics:
 - 1. Core:
 - a. Material: High Density Polyethylene Geonet Drainage Core
 - b. Thickness: 0.25", nominal, normal duty.
 - c. Compressive strength: 30,000 PSF.
 - d. Must be suitable for vehicular traffic.

2. Geotextile:
 - a. Material: Non-woven needle punch polypropylene.
 - b. Weight: 4.0 oz. per square yard (136 g/m²), minimum.
 - c. Treat fabric for UV stability to meet requirements in SYSTEM DESCRIPTION Article above.
 - d. Permittivity: Meet requirements in SYSTEM DESCRIPTION Article above
3. Bonding core material to geotextile: Manufacturer's standard.
4. Transmissivity or Flow Q of composite construction, geotextile bonded to core when tested in accord with ASTM D4716-01 with hydraulic gradient of 1 with confining stress of 3600 PSF: 8.5 gallons/min/ft. width in accordance with ASTM D4716-01.

PART 3 - EXECUTION

EXAMINATION

- A. Verification of conditions:
 1. Examine conditions and substrates where products specified in this section are installed; submit written notification of unacceptable conditions or substrates.
 2. Submit copy of installer's report to Engineer within 72 hours of report receipt.
 3. Proceeding with construction activities of this section:
 - a. Indicates acceptance of conditions or substrates.
 - b. Additional work in this section due to pre-existing conditions not noted will not be paid as extra.

INSTALLATION

- A. Horizontal plaza slab and planter installation, general:
 1. Roll out drainage system material to cover entire deck surface in accordance with the manufacturer's reviewed installation instructions with core material facing in the proper direction.
 2. Butt adjacent panels; lap geotextile fabric and use adhesive to bond adjacent fabric panels in accordance with the manufacturer's installation instructions.
 3. Make cuts at deck drains in accordance with the drainage system material manufacturer's reviewed details to allow water flow to drain pipes.