

SECTION 32 13 26 – CONCRETE WALKWAYS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies concrete sidewalks, ramps, and miscellaneous flatwork on grade including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.
- B. Related Sections:
 - 1. Division 32 Section "Decorative Concrete" for special surface finishes.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

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

2.3 CONCRETE MATERIALS

- A. **Cementitious Material:** Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. **Portland Cement:** ASTM C 150, Type I.
- B. **Normal-Weight Aggregates:** ASTM C 33, graded, 1-inch (25-mm) nominal maximum coarse-aggregate size.
 - 1. **Fine Aggregate:** Free of materials with deleterious reactivity to alkali in cement.
- C. **Water:** ASTM C 94/C 94M and potable.
- D. **Air-Entraining Admixture:** ASTM C 260.
- E. **Chemical Admixtures:** Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. **Plasticizing Admixture:** ASTM C 1017/C 1017M, Type II.

2.4 CURING MATERIALS

- A. **Moisture-Retaining Cover:** ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- B. **Water:** Potable.
- C. **Clear, Waterborne, Membrane-Forming Curing and Sealing Compound:** ASTM C 1315, Type 1, Class A.

2.5 RELATED MATERIALS

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

2.6 CONCRETE MIXTURES

- A. **Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.**
- B. **Proportion normal-weight concrete mixture as follows:**

1. Minimum Compressive Strength: 3000 psi (20.7 MPa) at 28 days unless otherwise indicated.
2. Maximum Water-Cementitious Materials Ratio: 0.55.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
4. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.

2.7 FABRICATING REINFORCEMENT

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

2.8 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

3.2 STEEL REINFORCEMENT

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

3.3 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.4 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

3.5 FINISHING WALKS AND FLAT SLABS

- A. Trowel and broom finish exposed surfaces as indicated on the Drawings.
- B. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- C. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.

3.6 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.

2. **Moisture-Retaining-Cover Curing:** Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. **Curing Compound:** Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.7 CONCRETE SURFACE REPAIRS

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

3.8 FIELD QUALITY CONTROL

- A. **Testing and Inspecting:** Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 1. **Testing Services:** Tests shall be performed according to ACI 301.

END OF SECTION 32 13 26

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Expansion and contraction joints within cement concrete pavement.
 - 2. Joints between cement concrete and asphalt pavement.
- B. Related Sections include the following:
 - 1. Division 3 Section "Integrally Colored Concrete" for colors of joint sealants.
 - 2. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Verification: For each type and color of joint sealant required. Install joint-sealant samples in **1/2-inch- (13-mm-)** wide joints formed between two **6-inch- (150-mm-)** long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and experienced in the application of concrete joint sealants.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials to comply with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
 - 2. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F (4.4 deg C).
 - 3. When joint substrates are wet or covered with frost.
 - 4. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 5. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.
- B. Colors of Exposed Joint Sealants: Match integrally colored concrete where joints sealants are indicated within the colored slabs. Refer to Division 32 Section "Decorative Concrete" for colors.

2.3 COLD-APPLIED JOINT SEALANTS

- A. Multicomponent Sealant for Concrete: Gun-grade, 3-component material consisting of base, activator, and color catalyst and complying with the following requirements for formulation and with ASTM C 920 for type, grade, class, and uses indicated:
 - 1. Formulation: Type M; Grade NS; Class 25; Uses T/NT, A, M, and, as applicable to joint substrates indicated, O.
 - a. Products:
 - 1) L. M. Scofield Company: LITHOSEAL Trafficalk-3G.

2.4 JOINT-SEALANT BACKER MATERIALS

- A. General: Flexible foam, round in shape, dust free, chemically inert, compressible, of continuous length and 25-33 percent larger in diameter than width of the joint at time of application.
 - 1. Extruded from polyolefin foam with a nonabsorbent skin and an interior of open and closed cells.

2.5 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install backer materials of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of backer materials.
 - 2. Do not stretch, twist, puncture, or tear backer materials.
 - 3. Remove absorbent backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses provided for each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealants from surfaces adjacent to joint.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.
- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

- A. Clean off excess sealants or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations with repaired areas are indistinguishable from the original work.

END OF SECTION 32 13 73

SECTION 321400 - UNIT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Brick pavers set in aggregate and bituminous setting beds.
 - 2. Rough-stone pavers set in aggregate and mortar setting beds.
 - 3. Edge restraints.
- B. Related Sections include the following:
 - 1. Division 07 Section "Joint Sealants" for sealing control and expansion joints in unit pavers with elastomeric sealants.
 - 2. Division 31 Section "Earth Moving" for excavation and compacted subgrade.
 - 3. Division 32 Section "Concrete Paving" for concrete base under unit pavers and for cast-in-place concrete curbs and gutters serving as edge restraint for unit pavers.

1.3 SUBMITTALS

- A. Product Data: For materials other than water and aggregates.
- B. Product Data: For the following:
 - 1. Pavers.
 - 2. Bituminous setting materials.
 - 3. Mortar and grout materials.
 - 4. Edge restraints.
 - 5. Precast concrete curbs.
- C. LEED Submittals:
 - 1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
- D. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.
- E. Samples for Initial Selection: For the following:

1. Each type of unit paver indicated.
2. Joint materials involving color selection.
3. Exposed edge restraints involving color selection.

F. Samples for Verification:

1. Full-size units of each type of unit paver indicated.
2. Joint materials.
3. Exposed edge restraints.

G. Compatibility and Adhesion Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from one source with resources to provide materials and products of consistent quality in appearance and physical properties.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store liquids in tightly closed containers protected from freezing.
- E. Store asphalt cement and other bituminous materials in tightly closed containers.

1.6 PROJECT CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Weather Limitations for Bituminous Setting Bed:

1. Install bituminous setting bed only when ambient temperature is above 40 deg F (4 deg C) and when base is dry.
2. Apply asphalt adhesive only when ambient temperature is above 50 deg F (10 deg C) and when temperature has not been below 35 deg F (2 deg C) for 12 hours immediately before application. Do not apply when setting bed is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Protect unit paver work against freezing when ambient temperature is 40 deg F (4 deg C) and falling. Heat materials to provide mortar and grout temperatures between 40 and 120 deg F (4 and 49 deg C). Provide the following protection for completed portions of work for 24 hours after installation when the mean daily air temperature is as indicated: below 40 deg F (4 deg C), cover with weather-resistant membrane; below 25 deg F (minus 4 deg C), cover with insulating blankets; below 20 deg F (minus 7 deg C), provide enclosure and temporary heat to maintain temperature above 32 deg F (0 deg C).
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and higher.
 - a. When ambient temperature exceeds 100 deg F (38 deg C), or when wind velocity exceeds 8 mph (13 km/h) and ambient temperature exceeds 90 deg F (32 deg C), set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 BRICK PAVERS

- A. Brick Pavers: Light-traffic paving brick; ASTM C 902, Class SX, Type I, Application PA. Provide brick without frogs or cores in surfaces exposed to view in the completed Work.
 1. Basis-of-Design Product: The design for brick pavers is based on Pine Rumbled Pavers, Full Range Subject to compliance with requirements, provide the named product of the following:
 - a. Pine Hall Brick Company, Inc.
 2. Thickness: 2-1/4 inches (57 mm).
 3. Face Size: 4 by 8 inches (102 by 203 mm).
 4. Color: Full-range. As selected by Architect from manufacturer's full range.
- B. Brick Pavers: Heavy vehicular paving brick; ASTM C 1272, Type R, Application PA. Provide brick without frogs or cores in surfaces exposed to view in the completed Work.
 1. Basis-of-Design Product: The design for brick pavers is based on Pine Rumbled Pavers Full Range Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - a. Pine Hall Brick Company, Inc.

2. Thickness: 2-1/4 inches (57 mm).
3. Face Size: 4 by 8 inches (102 by 203 mm).
4. Color: Full-range. As selected by Architect from manufacturer's full range.

- C. Efflorescence: Brick shall be rated "not effloresced" when tested according to ASTM C 67.
- D. 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 and can be removed without damaging grout or brick. Do not coat unexposed brick surfaces.

2.2 ACCESSORIES

- A. Plastic Edge Restraints: Triangular PVC extrusions 3-1/8 inches (79 mm) high by 9-1/2 inches (241 mm) wide designed to serve as edge restraints for unit pavers; rigid type for straight edges and flexible type for curved edges, with pipe connectors and 3/8-inch (9.5-mm) diameter by 12-inch (300-mm-) long steel spikes.
1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - a. BRICKSTOP Corporation.
 - b. Dimex Corporation.
 - c. PAVE TECH Inc.
 - d. Ryerson, J. T. & Son, Inc.

2.3 AGGREGATE SETTING-BED MATERIALS

- A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with ASTM D 2940, subbase material.
- B. Graded Aggregate for Base: Sound, crushed stone or gravel complying with ASTM D 2940, base material.
- C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33 for fine aggregate.
- D. 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.
1. Provide sand of color needed to produce required joint color.
- E. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
1. Survivability: Class 2; AASHTO M 288.
 2. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
 3. Permittivity: 0.02 per second, minimum; ASTM D 4491.
 4. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- F. Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50

percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Apparent Opening Size: **No. 40 (0.425-mm)** sieve, maximum; ASTM D 4751.
3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
4. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

- G. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

2.4 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.
1. Provide sand of color needed to produce required joint color.

2.5 MORTAR SETTING-BED MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Sand: ASTM C 144.
- D. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gauging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering latex additives that may be incorporated into the Work include, but are not limited to, the following:
 2. Manufacturer: Subject to compliance with requirements, provide latex additive by one of the following:
 - a. Bonsal, W. R. Company.
 - b. Bostik Findley Inc.
 - c. Custom Building Products.
 - d. Laticrete International, Inc.
 - e. MAPEI Corp.

f. TEC Incorporated; H. B. Fuller Company.

E. Water: Potable.

2.6 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, composed of white or gray cement and white or colored sand as required to produce required color.

1. 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 sand-portland cement grout.

a. Manufacturer: Subject to compliance with requirements, provide latex additive by one of the following:

- 1) Bonsal, W. R. Company.
- 2) Bostik Findley Inc.
- 3) Custom Building Products.
- 4) Laticrete International, Inc.
- 5) MAPEI Corp.
- 6) TEC Incorporated; H. B. Fuller Company.

B. Polymer-Modified Grout: ANSI A118.7, sanded grout; in color indicated.

1. Manufacturer: Subject to compliance with requirements, provide polymer-modified grout by one of the following:

- a. Bonsal, W. R. Company.
- b. Bostik Findley Inc.
- c. Custom Building Products.
- d. Laticrete International, Inc.
- e. MAPEI Corp.
- f. TEC Incorporated; H. B. Fuller Company.

2. Product Type: Dry mix, containing ethylene vinyl acetate, in dry, redispersible form, prepackaged with other dry ingredients.

3. Product Type: Two-component mix, containing acrylic resin in liquid-latex form and prepackaged dry-grout mix complying with ANSI A118.6 and recommended by latex-additive manufacturer.

4. Product Type: Either dry mix, containing ethylene vinyl acetate, in dry, redispersible form, prepackaged with other dry ingredients, or two-component mix, containing acrylic resin or styrene-butadiene rubber in liquid-latex form and prepackaged dry-grout mix complying with ANSI A118.6 and recommended by latex-additive manufacturer.

C. Grout Colors: As selected by Architect from manufacturer's full range.

D. Water: Potable.

2.7 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)**.

2.8 MORTAR AND GROUT MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimum performance characteristics. Discard mortars and grout if they have reached their initial set before being used.
- B. Mortar-Bed Bond Coat: Mix neat cement or cement and sand with latex additive to a creamy consistency.
- C. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.
- D. Latex-Modified, Portland Cement Slurry Bond Coat: Proportion and mix portland cement, sand, and latex additive for slurry bond coat to comply with written instructions of latex-additive manufacturer.
- E. Job-Mixed, Polymer-Modified Portland Cement Grout: Add liquid-latex additive to portland cement and sand in proportion and concentration recommended by liquid-latex manufacturer. Proportion cement and sand to comply with written instructions of latex-additive manufacturer.
 - 1. Pigmented Grout: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1:10, by weight.
- F. Packaged, Polymer-Modified Grout Mix: Proportion and mix grout ingredients according to grout manufacturers written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas indicated to receive paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 2. Where pavers are to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations. Examine areas where waterproofing system is turned up or flashed against vertical surfaces and horizontal waterproofing. Proceed with installation only after protection is in place.

3.2 PREPARATION

- A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
- B. Clean concrete substrates to remove dirt, dust, debris, and loose particles.

- C. Proof-roll prepared subgrade according to requirements in Division 31 Section "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive base course for unit pavers.

3.3 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, and other defects that might be visible in finished work.
- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
- D. Exercise care in handling coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. Remove coating from bonding surfaces before setting brick.
- E. Joint Pattern: As indicated.
- F. Tolerances: Do not exceed **1/32-inch (0.8-mm)** unit-to-unit offset from flush (lippage) nor **1/8 inch in 10 feet (3 mm in 3 m)** from level, or indicated slope, for finished surface of paving.
- G. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide 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."
- H. Expansion and Control Joints: Provide joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.
- I. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
 - 1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
 - 2. Install job-built concrete edge restraints to comply with requirements in Division 03 Section "Cast-in-Place Concrete."
 - 3. Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.
- J. Provide steps made of pavers as indicated. Install paver steps before installing adjacent pavers.
 - 1. Where pavers set in mortar bed are indicated for steps constructed adjacent to pavers set in aggregate setting bed, install steps and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.

3.4 AGGREGATE SETTING-BED APPLICATIONS

- A. Compact soil subgrade uniformly to at least 95 percent of ASTM D 698 laboratory density.
- B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Place separation geotextile over prepared subgrade, overlapping ends and edges at least **12 inches (300 mm)**.
- D. Place aggregate subbase and base, compact by tamping with plate vibrator, and screed to depth indicated.
- E. Place aggregate subbase and base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.
- F. Place drainage geotextile over compacted base course, overlapping ends and edges at least **12 inches (300 mm)**.
- G. 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 constant until pavers are set and compacted.
- H. Treat leveling course with herbicide to inhibit growth of grass and weeds.
- I. Set pavers with a minimum joint width of **1/16 inch (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.
 - 1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- J. 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.
- K. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- L. Repeat joint-filling process 30 days later.

3.5 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 where indicated, in panels, by spreading bituminous material 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. After each panel is completed, advance first control bar to next position in readiness for striking adjacent panels. 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. Advance protective panels as work progresses, but maintain protection in areas subject to continued movement of materials and equipment to avoid creating depressions or disrupting alignment of pavers. If additional leveling of paving is required, and before treating joints, roll paving with power roller after sufficient heat has built up in the surface from several days of hot weather.
- 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.

3.6 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 setting 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 immediately after applying bond coat. Spread and screed setting 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. Cut back, bevel edge, remove, and discard setting-bed material that has reached initial set before placing pavers.
- 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 per 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 setting bed, apply uniform **1/16-inch- (1.5-mm-)** thick, slurry bond coat to 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)** nominal joint width unless otherwise indicated with variations not exceeding plus or minus **1/16 inch (1.5 mm)**.
- I. Grout joints as soon as possible after initial set of setting bed.
 - 1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
 - 2. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
 - 3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
 - 4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.
- J. Cure grout by maintaining in a damp condition for seven days, unless otherwise recommended by grout or liquid-latex manufacturer.

3.7 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.
- B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point up joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.
- C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.
 - 1. Remove temporary protective coating from brick pavers as recommended by protective coating manufacturer and as acceptable to unit paver and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

END OF SECTION 32 14 00

SECTION 321440 - BLUESTONE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bluestone pavers
2. Bluestone seat wall coping

B. Related Sections:

1. Division 03 Section "Cast in Place Concrete".
2. Division 32 Section "Concrete Walkways" for stone paver subslab.

1.2 SUBMITTALS

A. Samples for Initial Selection:

1. Bluestone units of each finish indicated.
2. Submit available sizes for paver selections

B. Product Data: Manufacturers standard product data and installation instructions

1.3 DELIVERY, STORAGE, AND HANDLING

A. Store cement and lime on raised platforms under waterproof, well ventilated cover.

B. Handle stone in a manner that will prevent chipping and other damage. Use suitable lifting devices. Protect stone with wood or other rigid cushioning materials.

1.4 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and units damaged by frost or by freezing conditions.

1. Install bluestone pavers when air temperatures are above 40 degrees F.
2. Make necessary provisions to keep Work from freezing for not less than 24 hours after installation.
3. Do not lower freezing point of mortar by use of antifreeze, calcium chloride or other additives.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Bluestone Pavers:

1. Sources:
 - a. Robinson Flagstones, Fort Washington, PA
 - b. "North River Bluestone" by Heldeberg Bluestone and Marble, Inc, East Berne, NY,
 - c. "Elk Brook Bluestone" by Johnston and Rhodes Bluestone Co., East Branch, NY.
2. Quality: Free from laminations and open "reeds".
3. Sizes: Random rectangular pavers
4. Finish:
 - a. For pavers: Pavers: Natural cleft, free from noticeable tool marks. The exposed surface plane shall not vary more than 1/8 inch per sq ft.
 - b. For wall Caps: "Thermal Finish." sawn from a cube of rock and edges are flamed for a more natural textured finish. Flamed top surface as well as one long edge flamed.
 - c. Dress all exposed edges.

2.2 MORTAR

- A. Portland Cement: ASTM C150, Type 1.
- B. Grout Sand: ASTM C404.
- C. Setting Bed Sand: ASTM C 136 with 100 percent passing the No. 4 sieve.
- D. Water: Clean and potable.

2.3 MORTAR MIXES

A. Setting Bed:

1. One part of Portland Cement
Three parts of dry setting bed sand.
No Lime is to be in setting mix.
2. Mix nearly dry with only sufficient moisture to make the mix hold together.

B. Pointing Mix:

1. One part of Portland cement
2 ½ parts grout sand
No lime is to be used in the pointing mix.
2. Mix nearly dry with only sufficient moisture to make the mix hold together.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas indicated to receive bluestone with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, and laitance.
- B. Clean concrete substrates to remove dirt, dust, debris, and loose particles.

3.3 INSTALLATION

- A. Lay bluestone pavers dry on the setting bed. Assure a pitch of ¼ inch per foot for drainage and tamp to obtain finished elevation.
- B. Lift bluestone pavers and butter the back of each stone with Type 1 Portland cement mixed to a consistency of thick cream. Cover bluestone paver completely, out to edges of the stone.
- C. Place paver back in the exact position and tamp with a rubber mallet to ensure complete contact with the setting bed.
 - 1. Maintain surface elevation by checking with a straight edge at regular intervals. Surface elevation for finished paving shall not exceed a tolerance of 1/8 inch in 10 foot.
- D. Wipe of excess mortar mix with sponge and water within 30 minutes of placement.
- E. Pointing:
 - 1. Allow stone to set 24 hours before pointing.
 - 2. Pack joints full with pointing mix, free of all voids and pits.
 - 3. Using a ¾ inch wide tool, strike joints with a slight concave finish.
 - 4. Within ½ hour of striking the joints, wipe with slightly damp sponge.
 - 5. Continue to use a fresh section of the sponge and change water regularly to assure a clean surface of the finished paver.

3.4 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace bluestone units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units.
- B. Clean all mortar and stains from surface of pavers as soon as possible after installation. Do not allow cement stains to dry on surface of bluestone.

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END OF SECTION 32 14 40

SECTION 32 31 19 - DECORATIVE METAL SECURITY FENCES AND GATES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Decorative perimeter security fence and gates .
 - 2. Pool fence and gates.
 - 3. Dog walk perimeter fence and gate .
 - 4. Green screen privacy fence and gates.
- B. Related Requirements:
 - 1. Section 033000 "Cast-in-Place Concrete" post concrete fill.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For complete layout including attachment systems to adjacent building, walls and trellis. Include complete assemblage of gate systems. Include plans, elevations, sections, details, and attachments to other work.
 - 1. Include coordination and details for perimeter gate access systems in association with other project wide security control systems.
- C. Samples: For each fence material and for each color specified.
 - 1. Provide Samples **12 inches (300 mm)** in length for linear materials.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For gate operators to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Lightning-Protection System: Maximum grounding-resistance value of 25 ohms under normal dry conditions.

2.2 DECORATIVE METALLIC-COATED-STEEL SECURITY FENCES

- A. Decorative Metallic-Coated-Steel 6' Perimeter Security Fence:

1. **Products:** Subject to compliance with requirements, **provide the following or approved equal :**

- a. **Ameristar Fence Products;** Montage Plus Commercial, 6' height, color black, 3 rail , with decorative ring between top rails. When wall mounted, pickets to be flush with bottom rail. In non- wall mounted conditions, pickets to extend below bottom rail.

- B. Pool Fence

:

1. **Products:** Subject to compliance with requirements, **provide the following or approved equal :**

- a. **Ameristar Fence Products;** Montage Plus Commercial, 4' height, color black, 2 rail , Pickets to be flush with bottom rail. Or
- b. **Ameristar Fence Products;** Aegis II 4' Height , color black , 2 rail , Pickets to be flush with bottom rail.

- C. Decorative Metallic, 4' Perimeter Fence at Dog Walk :

1. **Products:** Subject to compliance with requirements, **provide the following or approved equal :**

- a. Metalco: Twinbar fence system, 4' hgt, black color , pickets to be flush with top rail.

Or

- b. **Ameristar Fence Products;** Montage Plus Commercial, 4' height, color black, 2 rail , with 3' picket spacing pickets to be flush with bottom rail.

- D. Green Screen , decorative Metallic :

1. **Products:** Subject to compliance with requirements, **provide the following or approved equal :**
 - a. McNichols Designer Metals : Eco Mesh , 5' hgt, 3" frame depth, 2" mesh opening brick red color , with 42" hgt gate .

2.3 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Section 033000 "Cast-in-Place Concrete" with a minimum 28-day compressive strength of **3000 psi (20 MPa)**, **3-inch (75-mm)** slump, and **1-inch (25-mm)** maximum aggregate size[**or dry, packaged, normal-weight concrete mix complying with ASTM C 387/C 387M mixed with potable water according to manufacturer's written instructions**].
- C. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M and specifically recommended by manufacturer for exterior applications.

2.4 GROUNDING MATERIALS

- A. Grounding Conductors: Bare, solid wire for No. 6 AWG and smaller; stranded wire for No. 4 AWG and larger.
 1. Material above Finished Grade: **[Copper] [Aluminum]**.
 2. Material on or below Finished Grade: Copper.
 3. Bonding Jumpers: Braided copper tape, **1 inch (25 mm)** wide, woven of No. 30 AWG bare copper wire, terminated with copper ferrules.
- B. Grounding Connectors and Grounding Rods: Comply with UL 467.
 1. Connectors for Below-Grade Use: Exothermic-welded type.
 2. Grounding Rods: Copper-clad steel.
 - a. Size: **5/8 by 96 inches (16 by 2440 mm)**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.
- B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of **500 feet (152.5 m)** or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.
 - 1. Construction layout and field engineering are specified in Section 017300 "Execution."

3.3 DECORATIVE SECURITY FENCE INSTALLATION

- A. Install fences according to manufacturer's written instructions.
- B. Install fences by setting posts as indicated and fastening **rails and infill panels** to posts. Revise "Post Excavation" and "Post Setting" paragraphs below as needed if conditions include unstable or rocky soils.
- C. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed soil. Excavate holes to a diameter of not less than 4 times post size and a depth of not less than **24 inches (600 mm)** plus **3 inches (75 mm)** for each **foot (300 mm)** or fraction of **a foot (300 mm)** that fence height exceeds **4 feet (1.2 m)**.
- D. Post Setting: Set posts **in concrete** at indicated spacing into firm, undisturbed soil.
 - 1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
 - 2. Concrete Fill: Place concrete around **posts** and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
 - a. Concealed Concrete: Top [**2 inches (51 mm)**] below grade to allow covering with surface material. Slope top surface of concrete to drain water away from post.
 - 3. Posts Set in Concrete: Extend post to within **6 inches (150 mm)** of specified excavation depth, but not closer than **3 inches (75 mm)** to bottom of concrete.
 - 4. Posts Set into Concrete in Sleeves: Use galvanized-steel pipe sleeves with inside diameter at least **3/4 inch (20 mm)** larger than outside diagonal dimension of post, preset and anchored into concrete for installing posts.
 - a. Extend posts at least **5 inches (125 mm)** into sleeve.
 - b. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions; shape and smooth to shed water. Finish and slope top surface of grout to drain water away from post.
 - 5. Posts Set into Voids in Concrete: Form or core drill holes not less than **3/4 inch (20 mm)** larger than outside diagonal dimension of post.
 - a. Extend posts at least **5 inches (125 mm)** into concrete.
 - b. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink grout, mixed and placed to comply with grout manufacturer's written instructions. Finish and slope top surface of grout to drain water away from post.

3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.5 GROUNDING AND BONDING

- A. Fence Grounding: Install at maximum intervals of [1500 feet (450 m)] except as follows:
 - 1. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of [750 feet (225 m)]
 - a. Gates and Other Fence Openings: Ground fence on each side of opening.
 - 1) Bond metal gates to gate posts.
 - 2) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (460 mm) below finished grade.
- B. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a maximum distance of 150 feet (45 m) on each side of crossing.
- C. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (150 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
- D. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
- E. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- F. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.6 FIELD QUALITY CONTROL

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

1. Grounding-Resistance Tests: Subject completed grounding system to a megger test at each grounding location. Measure grounding resistance not less than two full days after last trace of precipitation, without soil having been moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural grounding resistance. Perform tests by two-point method according to IEEE 81.
2. Excessive Grounding Resistance: If resistance to grounding exceeds specified value, notify Architect promptly. Include recommendations for reducing grounding resistance and a proposal to accomplish recommended work.
3. Report: Prepare test reports of grounding resistance at each test location certified by a testing agency. Include observations of weather and other phenomena that may affect test results.

3.7 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Lubricate hardware, and other moving parts.

3.8 DEMONSTRATION

- A. **Train** Owner's personnel to adjust, operate, and maintain gates.

END OF SECTION 323119.13

SECTION 328400 – PLANTING IRRIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide a complete underground irrigation system for the site as shown and specified. The work includes: Automatic irrigation system including sleeving, piping, fittings, sprinkler heads, and accessories.
 - 1. Automatic irrigation system including piping, fittings, sprinkler heads, and accessories.
 - 2. Controller.
 - 3. Rain sensor.
 - 4. Control wire.
 - 5. Testing.
 - 6. Excavating and back filling irrigation system work.
 - 7. Booster pumps if necessary
 - 8. Sleeving under roads sidewalks decks and other structures as required- landscape contractor to coordinate with general contractors schedule for the installation of all sleeving.
- B. Contractor shall prepare detailed shop drawings for the proposed irrigation layout showing head layout, pipe sizes, valve locations, etc. 100% coverage shall be provided for all landscaped areas as indicated on the planting plans. The shop drawings shall be submitted to the landscape architect within 10 days after award of the contract for review and approval.
- C. Related Sections include the following:
 - 1. Division 32 Section "Exterior Plants"
 - 2. Division 32 Section "Turf and Grasses"

1.3 SUBMITTALS

- A. Submit manufacturer's product data and installation instructions for each of the system components to include controllers, electric valves, heads, controller, wire, pipe, fittings, valve boxes, manual valves, wire splices, and all other equipment installed on project. Submittals must be organized and semi-permanently bound in booklet form with a table of contents to each section. This book must be periodically updated as material changes on the project.
 - 1. Submit the following material samples:
 - a. Piping and fittings
 - b. Clamps
 - c. Wire connectors and sealer

2. Submit the following equipment samples:
 - a. Sprinkler heads, 1 of each type, complete with housing
 - b. Valves and valve access boxes
 - c. Controller
- B. Approved equipment samples will be returned to contractor and may be used in the work.
- C. Upon irrigation system acceptance, submit written operating and maintenance instructions. Provide format and contents as directed by the Irrigation Designer.
- D. Design Criteria:
 1. Provide design with 100% coverage of designated areas using head to head coverage.
 2. All areas to be watered in a eight hour water window
 3. Irrigation system to provide up to 8 inches of water in 30 days.
 4. Velocity of water in all irrigation piping not to exceed 5 feet per second.
 5. Friction loss in remote control valves not to exceed 10% of static water pressure.
 6. Minimize possible overthrow onto non-porous/pedestrian surfaces.
 7. Separate lawn, shrubs, and, annual beds by using separate zones of irrigation.
 8. Shrub and groundcover beds to be irrigated primarily with drip emitter systems .
 9. Booster pumps shall be a self enclosed manufactured by Flowtronex.
 10. Confirm adequacy of proposed meter and tap.
 10. Submit Shop Drawings to landscape architect.
- E. Submit for all necessary permits and approvals. Contractor shall conform to all requirements of The City of Durham, North Carolina.
- F. Submit any requests for substitutions. Substitutions shall be of equal or greater quality as determined by the landscape architect.

1.4 QUALITY ASSURANCE

- A. Installer's qualifications:
 1. Upon request, contractor must provide the following, to include name of contact, name of project, address of project, & phone number of contact. If this criteria cannot be met, then contractor will be disqualified:
 - a. General liability insurance to \$1,000,000.
 - b. Five verifiable references in North Carolina to attest to the contractor's ability to install.
 - 1) Projects of the size and complexity of this project
 2. Experience of individual working for the contracting company will not be accepted as qualified job submittals. Experience must come from the company. Omission of any required information will be grounds for disqualification.

3. Contractor's primary business is to be irrigation installation. Primary defined as 60% of the contractor's business is to be derived from irrigation installation. Verification may be required.
4. Only one irrigation bid will be accepted for the project. No additional qualified bids will be accepted.
5. Conform to applicable codes for piping and component requirements.
6. Materials, equipment, and methods of installation shall comply with the following codes and standards:
 - a. City of Durham, North Carolina standards.
 - b. National Fire Protection Association, (NFPA): National Electrical Code.
 - c. American Society of Testing and Materials, (ASTM).
 - d. National Sanitation Foundation, (NSF).
7. Obtain Irrigation Designer's acceptance of installed and tested irrigation system prior to installing backfill materials. All mainline PVC must meet these criteria.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver irrigation system components in manufacturer's original undamaged and unopened containers with labels intact and legible. Site contractor will provide staging area.
- B. Deliver plastic piping in bundles, packaged to provide adequate protection of pipe ends, both threaded and plain.
- C. Store and handle materials to prevent damage and deterioration.
- D. Provide secure, locked storage for valves, sprinkler heads, and similar components that cannot be immediately replaced, to prevent installation delays.

1.6 PROJECT CONDITIONS

- A. Confirm all underground and surface utility lines locations with utility locating service prior to trenching and installation.
- B. Protect existing trees, plants, lawns, and other features designated to remain as natural areas.
- C. Promptly repair damage to adjacent facilities caused by irrigation system work operations. Cost of repairs at Contractor's expense.
- D. Promptly notify the Irrigation Designer of unexpected sub-surface conditions.
- E. Exact locations of piping, sprinkler heads, valves, and other components shall be established by Contractor and the Owner in the field at time of installation. Contractor will stake mainline and all heads and valves and receive approval from Owner prior to excavation. Contractor is ultimately responsible for maintaining 100% coverage on entire irrigated site.
 1. Space sprinkler components as indicated.
 2. Minor adjustments in system layout will be permitted to clear existing fixed obstructions. Final system layout shall be acceptable to the Irrigation Designer and Owner.
- F. Cutting and patching:

1. Cut through concrete and masonry with core drills. Jackhammers not permitted.
2. Materials and finishes for patching shall match existing cut surface materials and finish. Exercise special care to provide patching at openings and exterior walls.
3. Methods and materials used for cutting and patching shall be acceptable to the Irrigation Designer.

PART 2 - PRODUCTS

2.1 MATERIALS – GENERAL

- A. Provide only new materials, without flaws or defects and of the highest quality of their specified class and kind to be provided.
- B. Comply with pipe sizes indicated. No substitution of smaller pipes will be permitted. Larger sizes may be used subject to acceptance of the Irrigation Designer. Remove damaged and defective pipe.
- C. Provide pipe continuously and permanently marked with manufacturer's name or trademark, size schedule and type of pipe, working pressure at 73 degrees F. and National Sanitation Foundation (NSF) approval.

2.2 PLASTIC PIPE AND FITTINGS

- A. Material Source and Quality: Use only new materials throughout. Use only those cleaners, solvents, primers, lubricants, and sealants specified herein and/or accepted and specified by the pipe and fitting manufacturers.
- B. Solvent Weld Joint Pipe: All plastic pipe shall be PVC 1120, Class 200, SDR 21, solvent weld joint, and be in accordance with the latest revision of ASTM Standard 2241. The pipe shall be supplied in twenty foot lengths. One end shall have an integral molded socket conforming to the outside diameter of the pipe.
- C. Above Ground Pipe: All pipe installed in an exposed location, regardless of size, shall be Type K copper water tube.
- D. Gasketed Fittings (bell and socket style): Gasketed fittings shall be iron pipe sized and manufactured of PVC, according to the Fitting Application Schedule.
- E. Solvent Weld Fittings: Meeting or exceeding the requirements set forth in ASTM D-2466, Polyvinyl chloride Schedule 40 Socket Type Pipe Fittings.
- F. Threaded Fittings: PVC pipe shall be adapted to male thread by the use of a Schedule 40 solvent weld coupling and a Schedule 80 threaded-one-end nipple. Schedule 40 PVC threaded male adapters are not acceptable. Schedule 40 PVC female threaded fittings are not acceptable.
- G. Fitting Application Schedule
 1. Service tap on 2.5" - gasketed x FNPT PVC.
 2. Service tap on 2" or smaller - gasketed x FNPT PVC or Schedule 40 solvent weld PVC with slip x FNPT reducer bushing.
 3. Threaded male adapter - Schedule 80 PVC TOE nipple with Schedule 40 PVC solvent weld coupling.
- H. Swing Joint Assemblies - PVC: Swing joints shall be used on all large turf sprinklers (Falcon or I-25) and all quick coupling valves. Swing joints for sprinklers shall be pre-manufactured

swing joint with male pipe thread at both ends. The swing joints shall have adjustment on 3 planes for maximum adjustment flexibility. Swing joints shall be rated at 200 psi combined loading.

2.2 SPRINKLERS

A. Turf Rotors

1. The full and part circle turf rotors shall be single stream, water lubricated, gear drive sprinklers. Those installed in the outfield shall be capable of covering a 61 foot radius when supplied with a base pressure of 60 psi with a discharge rate of 16.1 gpm. Those installed in the infield shall be capable of covering a 65 foot radius when supplied with a base pressure of 60 psi with a discharge rate of 17.4 gpm. The part circle sprinkler shall have adjustable arc coverage of 40 to 360 degrees. Arc adjustment can be performed with or without the rotor in operation and shall require only a flat blade screwdriver. The sprinkler shall be capable of full circle (360 degree) operation in either the single direction mode (FC) or the bi-directional mode (PC). The sprinkler shall have a rotating nozzle turret independent of the riser stem. The portion of the riser stem that is in contact with the wiper seal shall be non-rotating.
2. The sprinkler shall have a pressure activated, multi-function, soft elastomeric wiper seal that will clean debris from the pop-up stem as it retracts. This wiper seal shall prevent the sprinkler from sticking in the up position, and be capable of sealing the sprinkler riser stem to the sprinkler cap under normal operating pressures. The sprinkler shall have a tapered plastic riser stem that will assist in the flushing mode of the sprinkler as it pops up, as well as when it pops down. The tapered stem shall seal positively against the multi-function wiper seal to assure no flow-by when fully activated.
3. The sprinkler shall have a screen attached to the drive housing to filter inlet water, protect the drive from clogging, and simplify its removal for cleaning and flushing of the system. The sprinkler body shall have a double-wall construction 1-inch female NPT bottom inlet.
4. The sprinkler shall have a standard rubber cover which designates the full circle sprinkler from the top, as well as designates each adjustment opening from the top. The sprinkler shall have a front-load nozzle assembly which will allow the nozzle to be installed without a stator bushing change. The sprinkler shall have four color-coded nozzles that are molded independently of each other to prevent waste of unused materials. The sprinkler shall have a stainless steel adjusting screw capable of reducing the radius up to 25%. The angle of trajectory shall be 25 degrees from the horizontal.
5. The sprinkler shall have a strong stainless steel retract spring for positive pop-down. The sprinkler shall have a standard Seal-A-Matic™ (SAM) device capable of holding up to 10 feet of head. Pop-up height as measured from the top of the cover to the middle of the nozzle orifice shall be 3 7/8 inches. The sprinkler's overall height shall be 8 1/2 inches and the diameter shall be 3 5/16 inches.
6. The sprinkler shall be manufactured by An approved manufacturer .

B. Spray Sprinklers

1. The full or part circle pop-up spray type sprinkler shall be capable of covering up to a 15 foot radius when operating at 30 psi with a discharge rate of up to 3.7 gpm. The overall pop-up height shall be 12 inches.
2. The sprinkler body, stem, nozzle, and screen shall be constructed of heavy-duty, ultra-violet resistant plastic. It shall have a heavy-duty stainless steel retract spring for positive pop-down and a ratcheting system for easy alignment of the pattern.

3. The sprinkler shall have a soft elastomer, pressure activated, co-molded wiper seal for cleaning debris from the pop-up stem as it retracts into the case to prevent the sprinkler from sticking up and to minimize "flow-by".
4. The sprinkler shall have a matched precipitation rate (MPR) plastic nozzle with an adjusting screw capable of regulating the radius and flow. The sprinkler shall be capable of housing under the nozzle protective, non-clogging filter screens or pressure compensating (PCS) screens. The screen shall be used in conjunction with the adjusting screw for regulating. The sprinkler shall have both a side and bottom 1/2" FNPT inlet for ease of installation.
5. The sprinkler shall have a Pop-Top Flush Plug pre-installed. The plug shall prevent debris from clogging the sprinkler during installation and allow for system to be flushed before nozzling. The plug shall be bright orange in color and constructed of polypropylene plastic.
6. The sprinklers shall include a pressure regulating device to prevent high pressure fogging of the nozzle stream. This regulating device shall be an integral part of the pop-up stem, removable through the top of the case. These units shall be identifiable from the top with "PRS" markings on the cap.
7. The device shall regulate the nozzle pressure to 30 PSI for inlet pressures ranging between 35 and 70 PSI. Below 35 PSI the pressure loss shall not exceed 6 PSI.
8. The sprinkler shall be manufactured by An approved manufacturer.

2.3 VALVES

- A. Bronze Body, Threaded, Manual Valves: Isolation valves shall be Hammond Model 606, sized as noted on the drawing.
- B. Valve Boxes: Valve boxes are to be high impact plastic as manufactured by Brooks, or equal. 'Economy' grade boxes are not acceptable.
- C. Quick Coupling Valves
 1. The quick coupling valve shall be a two piece type capable of having a discharge rate of 20 gpm with a pressure loss not to exceed 4.4 psi.
 2. The valve body shall be constructed of heavy cast brass. The cover shall be a durable, protective self-closing rubber cover.
 3. The valve shall be opened and closed by a brass key of the same manufacturer having a 1" MNPT and 3/4" FNPT outlet. The valve throat shall have a keyway with ACME threads for safe, continuous regulation of water flow.
 4. The quick coupling valve shall be manufactured by An approved manufacturer.
- D. Remote Control Valve
 1. The remote control valve shall be a normally closed 24 VAC 50/60 cycle solenoid actuated globe pattern valve. The 1" model shall be capable of having a flow rate of 20 gpm with a pressure loss not to exceed 2.5 psi. The 1.5" model shall be capable of having a flow rate of 75 gpm with a pressure loss not to exceed 3.9 psi. The valve pressure rating shall not be less than 200 psi.
 2. The valve body and bonnet shall be constructed of heavy-duty glass-filled UV-resistant nylon and have stainless steel studs and flange nuts; diaphragm shall be of nylon reinforced nitrile rubber.

3. The valve shall have both internal and external manual open/close control (internal and external bleed) for manually opening and closing the valve without electrically energizing the solenoid. The valve's internal bleed shall prevent flooding of the valve box.
4. The valve shall house a fully-encapsulated, one-piece solenoid. The solenoid shall have a captured plunger with a removable retainer for easy servicing, and a lever handle for easy turning. This 24 VAC 50/60 Hz solenoid shall open with 19.6 volt minimum at 200 psi. At 24 VAC average inrush current shall not exceed 0.41 amps.
5. The valve shall have a brass flow control stem for accurate manual regulation and/or shut-off of outlet flow. The valve must open or close in less than 1 minute at 200 psi, and less than 30 seconds at 20 psi.
6. The valve construction shall be such as to provide for all internal parts to be removable from the top of the valve without disturbing the valve installation.
7. The valve shall be Model PGA as manufactured by An approved manufacturer.

E. Backflow Preventor.

1. The backflow preventor shall be a reduced pressure zone unit, meeting or exceeding the requirements for flow rates and head loss of FCCCHR at U.S.C., ASSE Standard 1013, ANSI/AWWA C511-89, IAPMO (UPC), and CSA B64.4.
2. Body shall be bronze meeting ASTM Standard B584-89. Internal parts shall be made from corrosion resistant materials.
3. The unit shall be equipped at the inlet and outlet with ball valves and unions.
4. The backflow preventor shall be Wilkins model 975U.

2.4 CONTROL SYSTEM

A. Irrigation Controller

1. The irrigation system controller shall be of a hybrid type that combines electro-mechanical and microprocessor-based circuitry capable of fully automatic and manual operation. The controller will be housed in a weatherproof, lockable, 16 gauge seamless steel cabinet suitable for wall mounting or free-standing pedestal mounting.
2. The controller shall operate on a 117 vac $\pm 10\%$ power input and be capable of actuating up to two 24 vac, 7 va solenoid valves per station plus a master valve or pump start relay. The controller shall be capable of operating four stations plus the master valve simultaneously. Controller output shall be protected against severe electrical surge.
3. The controller shall have four separate irrigation programs (A, B, C, & D) which can have different start times, watering days, day cycles, and station timing. Each program shall have eight start times per day.
4. The controller shall have 40 stations, with each station capable of operating time of 0 to 2 hours in one minute increments, and 2 to 12 hours in 10 minute increments. Controller station operation shall be of automatic sequential stacking to avoid overlapping operation unless programmed to overlap.
5. The controller shall have a 365 day calendar with day of the month OFF feature. Programs will run on an ODD/EVEN day cycle, day of the week ON/OFF cycle, or in cycles from 1 to 99 days. In addition, the controller shall have a programmable rain shut-down from 1 to 99 days.

6. The controller shall have two master valve/remote pump start circuits for use with a master valve to pressurize the system when the irrigation cycle starts or to activate a remote pump start relay to run the pump during the irrigation cycle. One master valve/pump start circuit shall be programmable by station; the other shall function at all times.
7. The controller shall be capable of being operated manually at any time. A manual single station, a group of stations, or a program can be selected to run for the programmed time without affecting the normal program. This controller shall be capable of running a variable system test program without affecting the normal program.
9. The controller shall have Cycle + Soak™ water management software which is capable of operating each station for a maximum cycle time and a minimum soak time to reduce water run-off and puddling. The maximum cycle time shall not be extended by water budgeting.
10. The controller shall have an internal non-volatile memory which will retain the irrigation program and the programmed date and time for a minimum of 100 years without power. A 9 VDC rechargeable battery and recharging circuit shall also be included for counting down the program in progress during a power outage and shall allow programming of the controller when it is disconnected from the main power supply.
11. There shall be a station status indicator light and a master valve status indicator light. These lights will indicate station operation and circuit integrity. An indicator for sensor status will be found on the front panel along with a switch to suspend sensor operation. This indicator and override will work with a sensor wired to the controller's sensor terminals.
12. The controller shall be Model ESP-40MC as manufactured by An approved manufacturer.

B. Rain Sensor

1. The rain sensor shall be a micro-electronic, solid-state type, capable of interrupting the power from the irrigation controller to the valves when rainfall exceeds a preselected amount.
2. The sensor shall have an integral ratcheting pivot mount that allows installation on angled, as well as perpendicular surfaces. The sensor shall be capable of operation with up to a three 24 VAC (5.5 VA) valve load.
5. The sensor shall be Model An approved manufacturer.

2.5 WIRING

- A. N/A 120/240 Volt Power Wire: Power wire carrying 120/240 volt AC to the booster pump shall be type UF, with equal sized ground. Wire size is to be determined as a function of the distance to the electrical source, and shall not produce a voltage drop in excess of 5% due to the motor load. The two 240 volt AC hot wires will be black in color. The neutral, if used, will have a white jacket. The ground wire will have a green jacket.
- B. Underground Utility Tape: Underground utility warning tape shall be used to protect all underground power and communication wire. Tape shall be two inches (2") wide.

- C. 24 Volt Valve Wire: The 24 volt valve control wire shall be copper type UF irrigation control wire. All valve control wires shall be 14 AWG and shall be red in color. All 24 volt common wires shall be 14 AWG and shall be yellow in color.
- D. Wire Splices
 - 1. Valve control wire, 14 AWG, shall be spliced using 3M Corporation model DBY or DBR direct burial splice kits.
 - 2. Power wire, 120/240 vac, shall be spliced using 3M Corporation model DBY-6 or DBR-6 direct burial splice kits.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine final grades and installation conditions. Verify that field measurements are as shown on drawings. Do not start irrigation system work until unsatisfactory conditions are corrected.
- B. Verify that required utilities are available, in proper location, and ready for use.
- C. Beginning of installation means installer accepts existing conditions.
- D. Contractor must provide one experienced on-site foreman or supervisor subject to approval of the landscape architect, who must be on site at all times when a crew is working.

3.2 PREPARATION

- A. Prior to excavation, utility companies shall be notified in accordance with local codes and ordinances.
- B. Contractor shall be responsible for damage to existing utilities and structures due to negligence and/or misuse by his crews or equipment.
- C. Layout and stake the location of each pipe run and all sprinkler heads and sprinkler valves. Obtain landscape architect or owners representatives acceptance of layout prior to excavating.
- D. Strip sod for pipe trenches with a mechanical sod stripper uniformly 6" to 12" wide with clean-cut edges.
- E. Place sleeves as necessary for installation of piping and control wire. All piping under walks and walls shall be within a Class 200 PVC sleeve 2 sizes larger than the pressure pipe.

3.3 INSTALLATION

- A. Excavating and back filling:
 - 1. All excavation shall be considered unclassified excavation and include all material encountered.
 - 2. Excavate trenches of sufficient depth and width to permit proper handling and installation of pipe and fittings.

3. Excavate to depths required to provide 3" depth of debris free earth fill or sand bedding for piping when rock or other unsuitable bearing material is encountered.
4. Fill to match adjacent grade elevations with approved earth fill material. Place and compact fill in layers not greater than 8" depth.
 - a. Provide approved earth fill or sand to a point 4" above the top of pipe.
 - b. Fill to within 6" of final grade with approved excavated or borrow fill materials free of lumps or rocks larger than 1" in any dimension.
 - c. Provide clean topsoil fill free of rocks and debris for top 6" of fill.
5. Install irrigation lateral lines with a minimum cover of 18" based on finished grades. Install irrigation mainline with a minimum of 24" based on finished grade.
6. Excavate trenches and install piping and fill during the same working day. Do not leave open trenches or partially filled trenches open overnight.
 - a. Replace stripped sod in sufficient time to allow for satisfactory sod recovery and growth.
 - b. Water stripped and reinstalled sod until irrigation system is placed in operation.
7. Valves boxes installed per specifications on design.
8. All gasketed PVC pipe must be thrust blocked at all gasketed fitting connections. This includes any gasketed gate valve assemblies. Thrust block must be poured against native soil compaction. Utilize rebar as necessary. Brick, block or stone will not be acceptable thrust block material.
9. All trenches to be tamped with a mechanical power tamp to 90% compaction

B. Plastic Pipe

1. Install plastic pipe in accordance with manufacturer's installation instructions. Provide for thermal expansion and contraction. Do not install plastic pipe if temperature is below 32 degrees.
2. Saw cut plastic pipe. Use an electric miter saw, to ensure a square cut. Remove burrs and shavings at cut ends prior to installation.
3. Make plastic to plastic joints with solvent weld joints or slip seal joints. Use only solvent recommended by the pipe manufacturer. Install plastic pipe fittings in accordance with pipe manufacturer's instructions. Contractor shall make arrangements with pipe manufacturer for all necessary field assistance.
4. Make plastic to metal joints with plastic male adapters.
5. Make solvent weld joints in accordance with manufacturer's recommendations.
6. Allow joints to set **at least 24 hours** before pressure is applied to the system.
7. Maintain pipe interiors free of dirt and debris. Close open ends of pipe by acceptable methods (duct tape ends) when pipe installation is not in progress.
8. All pipe routed through sleeves will be banded with a steel banding tool to wooden blocks to prevent vibration of the pipe inside of sleeve.

C. Sprinklers, fittings, valves, and accessories:

1. Install fittings, valves, sprinkler heads, risers, and accessories in accordance with manufacturer's instructions, except as otherwise indicated.
2. Set sprinkler heads perpendicular to finished grades, except as otherwise indicated.
3. Locate sprinkler heads to assure proper coverage of indicated areas. Do not exceed sprinkler head spacing distances indicated.
4. Install quick-coupling valves with an adjustable double swing joint riser assembled by the use of at least 3 standard 90-degree elbows. Fabricate double swing joint risers of

schedule 80 PVC nipples and schedule 40 PVC elbows. Pre-fabricated swing joints are acceptable.

5. Install valve access boxes on a suitable base of bricks to provide a level foundation at proper grade and to provide drainage of the access box. 1 cubic feet of pea gravel below box to be provided for drainage.
6. Automatic valves shall be installed plumb with valve access box with all valve handles, bolts, connections and electrical splices accessible through the valves box opening (not less than 6" below valve box cover).
7. All seal threaded connections of control valves with Teflon tape. **Plastic joint type compound is not acceptable.**

D. Control Wiring:

1. Install electric control cable in the piping trenches wherever possible. Place wire in trench adjacent to pipe. Install wire with slack to allow for thermal expansion and contraction.
Expansion joints in wire may be provided at 200-foot intervals. Where necessary to run wire in a separate trench, provide a minimum cover of 15". Wire cannot be plowed or pulled with a vibratory plow.
2. Provide sufficient slack at site connections at remote control valves in control boxes and at all wire splices to allow raising the valve bonnet or splice to the surface without disconnecting the wires when repair is required.
3. Connect each remote control valve to one station of a controller except as otherwise indicated.
4. Connect remote control valves for each controller to a common ground wire system, independent of all other controllers.
5. Make wire connections to remote control electric valves and splices of wire in the field, using water proof wire connectors and sealing cement in accordance with manufacturer's recommendations, dry splices will not be accepted. Make wire splices in accessible splice or valve boxes 10" in diameter or greater.
6. Provide tight joints to prevent leakage of water and corrosion build-up on the joint.
7. When control wiring is in common trench with main line, wiring shall be below main line with 4" of fill dirt between pipe and wire.
8. Aboveground wire is to be installed in conduit and/or in accordance with electrical codes.
9. All materials and methods of installation shall conform to local electrical codes.

E. Flushing, testing, and adjustment

1. After sprinkler piping and risers are installed and before sprinkler heads are installed, open control valves and flush out the system with full head of water.
2. Perform system testing upon completion of each section. Make necessary repairs and retest repaired sections as required.
3. Adjust sprinklers after installation for proper and adequate distribution of the water over the coverage pattern. Adjust for the proper arc of coverage.
4. Adjust all electric remote control valve flow control stems for system balance. Contractor must set pressure-regulating valves prior to acceptance specification on design.
5. Test and demonstrate the controller by operating all programs, day, hour, and station selection features as required to automatically start and shut down irrigation cycles to accommodate plant requirements and weather conditions.

F. Service:

1. When requested, return to the site during the subsequent fall season and winterize the system. Drain all water from the system and blow out the system with compressed air.

2. When requested, return to the site during the subsequent spring season and demonstrate to the Owner Representative the proper procedures for the system start-up, operation, and maintenance.
3. After 3 months of continuous operation, after acceptance of job, contractor must return to the site and re-adjust all irrigation heads, by re-packing heads that have become dislodged due to resettling of ground, torque of spray, or vibration. Re-adjust radius, arc, and trajectory of spray of all heads.

3.4 DISPOSAL OF WASTE MATERIAL

- A. Stockpile, haul from site, and legally dispose of waste materials, including unsuitable excavated materials, rock, trash, and debris.
- B. Maintain disposal route clear, clean, and free of debris.

3.5 ACCEPTANCE

- A. Test and demonstrate to the landscape architect or owner's representative the satisfactory operation of the system free of leaks.
- B. Instruct the Owner's designated personnel in the operation of the system including adjustment of sprinklers, controller(s), valves, and pump controls.
- C. Upon acceptance, the Owner will assume operation of the system.
- D. Provide owner with 2 quick coupler keys with swivels for use on project.
- E. Provide Owner with all manuals for products used on project.
- F. Provide Owner with 1 key for every seven manual valves used on project. More than one type of valve may require more than one type of key.
- G. Provide irrigation system Record Drawings:
 1. Legibly mark drawings to record actual construction. Use surveyors location devices to mark all heads, valves, and wire splice boxes in AutoCAD 2000 DWG (or later release) format.
 2. Indicate a measured distance triangulated to locate each installed valve-automatic, manual, quick-coupling type.
 3. Identify field changes of dimension and detail and changes made by Change Order, if any.
 4. Submit 3 copies of Record Drawings to the owner on base drawings provided by the irrigation designer.
 5. Record Drawings shall also indicate control valve wiring routing paths, wire splice locations, and controller location.

3.6 GUARANTEE

- A. The contractor shall guarantee all workmanship covered by the specifications to be free of defects for a period of one (1) year from the date of final acceptance of the project. He shall

replace any part or parts found to be defective within the period of guarantee at no cost to the owner, except repairs or replacement necessitated by damage by others.

- B. Back filling of all excavation shall be guaranteed. If, at any time during the first year of the guarantee period, trenches or heads should settle, the irrigation contractor shall repair any settling at no cost to the Owner.

3.7 CLEANING

- A. Perform cleaning during installation of the work and upon completion of the work. Remove from site all excess materials, soil, debris, and equipment. Repair damage resulting from irrigation system installation.

END OF SECTION 32 84 00

SECTION 329113 – STRUCTURAL SOIL FOR FIRE LANE

PART 1: GENERAL

1.1 Related Documents

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

1.2 SUMMARY:

A. Section Includes:

- 1. Components and mixing of structural soils for the fire lane.

B. Related Sections Include:

- 1. Division 32 Section "Earthwork" for subgrade
- 2. Division 32 Section "Concrete Paving" for paving within firelane
- 3. Division 32 "Turf and Grasses" for sodding of firelane.
- 4. Division 32 "Irrigation" for piping and irrigation within firelane

1.2 SUBMITTALS:

- A. Product Data: For each type of product indicated.
- B. Material test reports.
- C. Source quality-control reports.

1.3 QUALITY ASSURANCE:

- A. Installer Qualifications: An employer of workers experienced in the mixing and placement of structural soil mixes comparable with this application.
- B. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548.

PART 2: PRODUCTS

2.1 STRUCTURAL SOIL

- A. Provide a Structural Soil Mix using the three components below to meet ASTM Standards as follows:

- 1. The Structural Soil Mix shall be a special pre-mixed blend of 75% 5/16" graded Stalite Expanded Slate Aggregate and 25% approved sand-compost blend compacted to a minimum depth of ten inches.

5/16" Expanded Slate	75%
USGA Root Zone mix*	20% typical

Certified Compost* 5% typical

* Percentages may vary to meet testing requirements
Saturated Drain Weight: 66 pounds per Cubic Foot

2. Minimum finished depth shall be not less than 10" (ten inches) deep.

Source: Triangle Landscape Supply, Jeff Mangum or approved equal

2.2 STRUCTURAL SOIL COMPONENTS

A. 5/16" Stalite Rotary Kiln Expanded Aggregate

1. ASTM C29 Unit Dry Weight loose (48 lb./cf to 55 lb./cf)
2. ASTM C127 Specific Gravity to meet 1.45 to 1.60, SSD
3. ASTM C330: ASTM Gradation 3/8" - #8 size

3/8" - #8 PermaTill Expanded Aggregate

Sieve Size	% Passing
1/2"	100
3/8"	80 - 100
#4	50 - 40
#8	0 - 20
#16	0 - 10

4. Test for degradation loss using Los Angeles Abrasion testing in accordance with ASTM C-131 modified method FM 1-T096. No more than 28% of the weight of the aggregate must be lost to degradation.

B. USGA Root Zone Sand

1. Grain Size Distribution

Sieve Size	% Retained
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
organic matter	5% - 10%

C. Compost

1. Compost must be certified and derived from a non-sewage sludge feedstock source. The addition of yard waste to the composting process must also meet certification requirements.
2. Finished compost must be screened to minus 1/2", protected, and free from any outside contaminants during and after screening and curing.
3. Metals and contaminants must meet or exceed US EPA Standard 40

2.3 MIXING OFFSITE

A. Structural Soil

1. Mechanically mix the sand and compost thoroughly.
2. Saturate the 5/16" Expanded Slate Aggregate with water and mechanically mix 3:1 with the dry sand-compost until the slate particles are completely coated.
3. When stockpiling the finished mix, cover the pile with a plastic tarp to prevent drying out or soil separation from rain.
4. Install the mix within 48 hours after mixing.

PART 3: EXECUTION

3.1 PREPARATION

A. GENERAL

1. The contractor shall obtain necessary approvals before placing each Structural Soil layer.
2. The contractor shall use adequate numbers of skilled workmen who are thoroughly trained in the necessary crafts and are completely familiar with the specified requirements and methods needed for proper performance of the work in this section.
3. The contractor must provide access for and cooperate with the testing laboratory.
4. Adequacy of the final compaction of all elements requiring compaction shall be determined in the field by the engineer by proof roll.

B. PREPARING SUBGRADE

The subgrade shall be prepared according to these procedures:

- a. Remove all organic matter, debris, loose material and large rocks.
- b. Dig out soft and mucky spots then replace with suitable material.
- c. Loosen hard spots and uniformly compact the subgrade to 95% of its maximum dry density.

C. PERFORATED UNDERDRAIN SYSTEM

1. The underdrain system shall be installed, included with sock or soil separator fabric, according to drawing and specifications, and connected to the storm drain.

3.2 PLACEMENT OF STRUCTURAL SOIL MIX

A. GENERAL

1. Adequacy of the final compaction shall be determined in the field by the geo technical engineer by proof roll.
2. Place geo-tech mesh where specified.

3. The Structural Soil shall be placed in approximately five inch uniform lifts over the entire area of project and each lift compacted to provide a finished depth of 10". Construction equipment, other than for compaction, shall not operate on the exposed structural soil mix. Over- compaction should be avoided.
4. Final compacted depth of the material shall be not less than 10" deep.
5. Irrigation systems are to be installed and tested prior to the root zone laying course installation to avoid disturbing the compaction of the mix.

B. COMPACTING

1. Use of portable vibratory plate compacting machine (Recommended).
 - a) Place structural soil mix in horizontal lifts not exceeding 5 inches of compacted depth. Use a minimum of four passes, of not less than 10 seconds per pass, before moving the vibratory plate to the next adjacent location. Additional passes may be required and should be determined in the field by the engineer to insure stability of the layer. Continue placing and compacting 5" lifts until the specified depth is reached.
2. Use of vibratory steel roller for large areas.
 - a) For large spaces, a vibratory steel roller weighing no more than 12 tons static weight can be used. Horizontal lifts should not exceed 5" compacted. The minimum number of passes is two and maximum number is four. Additional passes may be required and should be determined in the field by the engineer to insure stability of the layer.

3.3 SOD INSTALLATION

- A. Only sod grown in a sand base soil may be used in this application.
- B. Place sod directly on the structural soil as specified by the Landscape Architect.

3.4 PROTECTION

- A. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION

SECTION 32 91 14 – STRUCTURAL SOIL ROOT PATH

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Components and mixing of structural soils.
 - 2. Tree planting within structural soil mix.
- B. Related Sections :
 - 1. Division 32 Section “Earthwork “ for subgrade preparation
 - 2. Division 32 Section “Concrete Paving”
 - 3. Division 32 Section “Unit Pavers”
 - 4. Division 32 Section “Exterior Plants” for tree pit planting.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Material test reports.
- C. Source quality-control reports.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers experienced in the mixing and placement of structural soil mixes comparable with this application.
- B. Testing Agency Qualifications: An independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548.

PART 2 - PRODUCTS

2.1 STRUCTURAL SOIL

- A. Provide a structural soil mix that conforms to the following:
 - 1. Stalite Expanded Slate - 3/4 inch 80%
 - 2. Sandy Clay Loam * 20%

*Percentages of sand and clay may vary to meet testing requirements

3. Air Filled Porosity: 10% - 15% by volume
4. Water Retention (ASTM D2325) at 0.1 bar: minimum of 10% - 12% by volume, up to 30%
5. Permeability (Hydraulic Conductivity) (ASTMD2434 or D5084): Minimum ¼ inch - ½ inch per hour

2.2 STRUCTURAL SOIL COMPONENTS

A. Expanded Slate:

1. ASTM C29 Unit Dry Weight loose (48 lbs/cf to 55 lbs/cf). Saturated Surface Loose (55 lbs/cf to 60 lbs/cf)
2. ASTM C127 Specific Gravity to meet 1.45 to 1.60 Dry Bulk
3. ASTM C330 to meet the ASTM Gradation ¾ inch - #4 size

Sieve Size	% Passing
1 inch	100
¾ inch	90 – 100
3/8 inch	10-50
#4	0 – 10

4. Test for degradation loss using Los Angeles Abrasion testing in accordance with ASTM C-131 modified method FM 1-T096. No more than 28% of the weight of the aggregate must be lost to degradation.

B. Sandy Clay Loam:

1. Texture:
 - a. 40% - 65% sand
 - b. 15% - 25% silt
 - c. 20% - 35% clay
 - d. 2% - 5% Organic matter

C. Source of Pre-Mixed Blend: Carolina Stalite Company

1. Contact: Triangle Landscape Supply, Jeff Mangum

2.3 MIXING OFFSITE

A. Structural Soil:

1. Mechanically mix the sand and loam thoroughly if mixing is required to meet specifications.
2. Saturate the ¾ inch Expanded Slate with water and mechanically mix the sandy clay loam until the slate particles are completely coated.
3. When stockpiling the finished mix, cover the pile with a plastic tarp to prevent drying out or soil separation from rain.
4. Install the mix within 48 hours of mixing.

2.4 TREE PIT BACKFILL PLANTING MIX

- A. A prepared mix containing 50 percent approved topsoil and 50 percent structural soil mix excavated from the tree pit preparation.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assure adequacy of the final compaction of all elements requiring compaction.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections to determine if compaction conforms to requirements.
- C. Preparation of Subgrade:
 - 1. Prepare subgrade as follows:
 - a. Remove all organic matter, debris, loose material and large rocks.
 - b. Dig out soft and mucky spots and replace with approved material.
 - c. Loosen hard spots and uniformly compact the subgrade to 95% of its maximum dry density.
- D. Verify that underdrain system is installed, including sock or soil separator as indicated, and connections have been made to the storm drain system.

3.2 PLACEMENT OF STRUCTURAL SOIL MIX

- A. General:
 - 1. Do not plant trees until structural soil placement is complete and pavers are installed.
- B. Installation;
 - 1. Place structural soil in approximately uniform lifts over the entire area of project compacting each lift, including the open tree pit areas.
 - 2. Minimum depth for large shade trees shall 36 inches.
 - 3. Minimum depth of 24 inches for small trees.
 - 4. Construction equipment, other than for compaction, shall not operate on the exposed structural soil mix.
 - 5. Avoid over-compaction.
 - 6. Do not allow foot or equipment traffic on the compacted material until the paving is installed.

3.3 COMPACTION

- A. Use of portable vibratory plate compacting machine.

- B. Place structural soil mix in horizontal lifts not exceeding 12 inches of compacted depth. Use a minimum of two passes, of not less than 10 seconds per pass, before moving the vibratory plate to the next adjacent location.
- C. Make additional passes as determined in the field by the engineer to insure stability of the layer.
- D. Continue placing and compacting 12 inch lifts until the specified depth is reached.
- E. Vibratory Steel Roller for Large Areas:
 - 1. For large spaces, a vibratory steel roller weighing no more than 12 tons static weight may be used.
 - 2. Horizontal lifts are not to exceed 12 inches compacted.
 - 3. The minimum number of passes is two and maximum number is four. Additional passes may be required and as determined in the field by the engineer to insure stability of the layer.

3.4 PLACEMENT OF PAVERS

- A. Aggregate layer course and paver placement are specified in Division 32 Section "Unit Pavers" and Division 32 Section "Concrete Paving".

3.5 TREE PLANTING

- A. Tree Pit Excavation:
 - 1. After the pavement is placed, excavate the structural soil mix to a depth equal to the height of the root ball of the tree to be planted.
 - 2. Remove the structural soil mix to within 12 inches of the edge of the paved area.
 - 3. Place the tree in the pit and backfill as soon as possible, as specified in paragraph "B".
 - 4. Remove excess soil on the top of the root ball that was filled above the root collar at the nursery.
 - 5. Do not leave a tree pit excavation to remain open for more than 2 hours unless forms are used.
- B. Tree Pit Backfill Planting Mix:
 - 1. Remove any optional wooden forms. Immediately place the tree in the pit as detailed and mix the excavated structural soil 50:50 with the approved topsoil. Backfill the planting mix into the pit around the root ball in 12 inch lifts and tamp until firm.
 - 2. Tamp the planting mix in 12 inch lifts until the pit is filled to the specified grade above the planting.
 - 3. Dispose of the excavated structural soil mix. Do not re-use as structural soil.

3.6 PROTECTION

- A. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

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END OF SECTION 32 91 13

SECTION 329200 – TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Seeding.
2. Sodding.
3. Erosion-control material(s).

- B. Related Sections:

1. Division 32 Section "Exterior Plants"
2. Division 32 Section "Structural Soil for Fire Lane for sodding requirements in fire lane zone."

1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Manufactured Soil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- C. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill immediately beneath planting soil.
- E. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

- C. Certification of Turfgrass Sod: Sod grown from documented planting source and has been inspected and certified by North Carolina Crop Improvement Association or equivalent association.
- D. Qualification Data: For qualified landscape Installer.
- E. Product Certificates: For soil amendments and fertilizers, from manufacturer.
- F. Material Test Reports: For existing surface soil and imported topsoil.
- G. Planting Schedule: Indicating anticipated planting dates for each type of planting.
- H. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of lawns during a calendar year. Submit before expiration of required initial maintenance periods.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful lawn establishment.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
 - 2. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
 - 1. Report suitability of topsoil for lawn growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
- D. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Seed: Deliver seed in original sealed, labeled, and undamaged containers.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in Turf Producers International's "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" in its "Guideline Specifications to Turfgrass Sodding." Deliver sod in time for planting within 24 hours of harvesting. Protect sod from breakage and drying.

1.7 PROJECT CONDITIONS

- A. Planting Restrictions: Plant during periods recommended for seed species indicated. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.

1.8 MAINTENANCE SERVICE

- A. Initial Lawn Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Seeded Lawns: 60 days from date of Substantial Completion.
 - a. When initial maintenance period has not elapsed before end of planting season, or if lawn is not fully established, continue maintenance during next planting season.
 - 2. Sodded Lawns: 30 days from date of Substantial Completion.

PART 2 - RODUCTS

2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species: State-certified seed of grass species, as follows:
 - 1. Fescue –Rebel III or approved equal

2.2 TURFGRASS SOD

- A. Turfgrass Sod: Certified, complying with Turf Producers International's "Specifications for Turfgrass Sod Materials" in its "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture, strongly rooted, and capable of vigorous growth and development when planted.
- B. Turfgrass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 85 percent pure seed, and not more than 0.5 percent weed seed:
 - 1. Fescue –Rebel III or approved equal
 - 2. Zoysia- "El Toro" or approved equal

2.3 TOPSOIL

- A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.
 - 1. Topsoil Source: Import screened topsoil mix from off-site sources. Topsoil to be 50/50 blend with 20% Stalite fines mixed in as supplied by Triangle Landscape Supply or approved equal.

2.4 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural limestone 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.
 - 3. Provide lime in form of dolomitic limestone.
- B. Sulfur: Granular, biodegradable, 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: Finely ground, containing a minimum of 90 percent calcium sulfate.
- G. Sand: Clean, washed, natural or manufactured, free of toxic materials.
- H. Diatomaceous Earth: Calcined, diatomaceous earth, 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.

2.5 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) 3/4-inch (19-mm) 1/2-inch (12.5-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:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.

- B. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- C. Peat: Finely divided or granular texture, with a pH range of 6 to 7.5, containing partially decomposed moss peat, native peat, or reed-sedge peat 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, free of chips, stones, sticks, soil, or toxic materials.
 - 1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. (2.4 kg/cu. m) of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. (4 kg/cu. m) of loose sawdust or ground bark.
- 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, and material harmful to plant growth.

2.6 PLANTING ACCESSORIES

- A. Selective Herbicides: EPA registered and approved, of type recommended by manufacturer for application.

2.7 FERTILIZER

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.8 MULCHES

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

- C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- D. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.9 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of 0.92 lb/sq. yd. (0.5 kg/sq. m), with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 inches (150 mm) long.
- C. .

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive lawns and grass for compliance with requirements and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
 - 1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
 - 2. Protect grade stakes set by others until directed to remove them.
- B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 LAWN PREPARATION

- A. Limit lawn subgrade preparation to areas to be planted.
- B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 6 inches (150 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer directly to subgrade before loosening.
 - 2. Thoroughly blend planting soil mix off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil mix.

3. Spread planting soil mix to a depth of 6 inches (200 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.
 - a. Spread approximately one-half the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 2 inches (100 mm) of subgrade. Spread remainder of planting soil mix.
 - b. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - c. Mix lime with dry soil before mixing fertilizer.
- C. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.
- D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- E. Before planting, restore areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. Prepare area as specified in "Lawn Preparation" Article.
- B. For erosion-control mats, install planting mix in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- C. Fill cells of erosion-control mat with planting mix and compact before planting.
- D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph (8 km/h). Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
 1. Do not use wet seed or seed that is moldy or otherwise damaged.
 2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Planting Rates:
 1. Fescue: 6 -8 lbs per 1,000 sq. ft.

- C. Rake seed lightly into top 1/8 inch (3 mm) of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding 1:6 with erosion-control fiber mesh installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where shown, installed and anchored according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 2 tons/acre (42 kg/92.9 sq. m) to form a continuous blanket 1-1/2 inches (38 mm) in loose depth over seeded areas. Spread by hand, blower, or other suitable equipment.
 - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
 - 2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft. (38 to 49 L/92.9 sq. m). Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- G. Protect seeded areas from hot, dry weather or drying winds by applying topsoil within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a depth of 3/16 inch (4.8 mm), and roll surface smooth.

3.6 SODDING

- A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.
- B. If sod rolls are prepared with netting, installer shall retrieve netting prior to laying out sod rolls
- C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 - 1. Lay sod across angle of slopes exceeding 1:3.
 - 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- D. Saturate sod with fine water spray within a half hour of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.7 LAWN RENOVATION

- A. Renovate existing lawn.
- B. Renovate existing lawn damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish lawn where settlement or washouts occur or where minor regrading is required.
 2. Provide new topsoil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury in soil.
- D. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.
- E. Mow, dethatch, core aerate, and rake existing lawn.
- F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches (150 mm).
- I. Apply soil amendments and initial fertilizers required for establishing new lawns and mix thoroughly into top 4 inches (100 mm) of existing soil. Provide new planting soil to fill low spots and meet finish grades.
- J. Apply seed and protect with straw mulch sod as required for new lawns.
- K. Water newly planted areas and keep moist until new lawn is established.

3.8 LAWN MAINTENANCE

- A. Maintain and establish lawn by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth lawn. Provide materials and installation the same as those used in the original installation.
1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
- B. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawn uniformly moist to a depth of 4 inches (100 mm).
1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
 2. Water lawn with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.
- C. Mow lawn as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow zoysia to a height of **1/2 to 1 inch (13 to 25 mm)**.
 2. Mow turf-type tall fescue to a height of **2 to 3 inches (50 to 75 mm)**.
- D. Lawn Postfertilization: Apply fertilizer after initial mowing and when grass is dry.
1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m) to lawn area.

3.9 SATISFACTORY LAWNS

- A. Lawn installations shall meet the following criteria as determined by Architect:
1. Satisfactory Seeded Lawn: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm).
 2. Satisfactory Sodded Lawn: At end of maintenance period, a healthy, well-rooted, even-colored, viable lawn has been established, free of weeds, open joints, bare areas, and surface irregularities.
- B. Use specified materials to reestablish lawns that do not comply with requirements and continue maintenance until lawns are satisfactory.

3.10 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris, created by lawn work, from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain until Substantial Completion.
- C. Remove nondegradable erosion-control measures after grass establishment period.

END OF SECTION 32 92 00

SECTION 329300 - EXTERIOR PLANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Trees.
2. Shrubs.
3. Ground cover.
4. Plants.
5. Tree stabilization.
6. Edgings.

- B. Related Sections:

1. Division 15 Temporary Tree and Plant Protection
2. Division 32 Section "Turf and Grasses" for lawn planting.
3. Division 32 Section "Structural Soil for Tree Root Path" for structural soil in tree planters adjacent to streets

1.3 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Exterior plants dug with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.
- D. Container-Grown Stock: Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.
- E. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.

- F. Finish Grade: Elevation of finished surface of planting soil.
- G. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
- H. Multi-Stem: Where three or more main stems arise from the ground from a single root crown or at a point right above the root crown.
- I. Planting Soil: Native or imported topsoil, manufactured topsoil, or surface soil modified to become topsoil; mixed with soil amendments.
- J. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- K. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each of the following:
 - 1. 5 lb (2.2 kg) of mineral mulch for each color and texture of stone required, in labeled plastic bags.
 - 2. Edging materials and accessories, of manufacturer's standard size, to verify color selected.
- C. Qualification Data: For qualified landscape Installer.
- D. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
 - 1. Manufacturer's certified analysis for standard products.
 - 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- E. Material Test Reports: For existing surface soil and imported topsoil.
- F. Planting Schedule: Indicating anticipated planting dates for exterior plants.
- G. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.
- H. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape contractor whose work has resulted in successful establishment of exterior plants. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
 2. Experience: **Five** years minimum experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
 4. Personnel Certifications: Installer's **field supervisor** shall have certification in the following categories from the Professional Landcare Network:
 - a. Certified Landscape Technician - Exterior, with **installation, maintenance and irrigation** specialty area(s), designated CLT-Exterior.
 - b. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
- B. Soil-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- C. Topsoil Analysis: Furnish soil analysis by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of topsoil.
1. Report suitability of topsoil for plant growth. State-recommended quantities of nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory topsoil.
- D. Provide quality, size, genus, species, and variety of exterior plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
- E. Tree and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches (150 mm) above the ground for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.
- F. Observation: Architect may observe trees and shrubs either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, insects, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
1. Notify Architect of sources of planting materials a minimum of 21 days in advance of delivery to site. Provide Architect with photographs of representative samples of all trees and plant materials specified as 42" in height and above in size.
- G. Preinstallation Conference: Conduct conference at Project site. At the preinstallation conference a sample area of at least 15' X 15' shall be prepared in accordance with the planting bed preparations in this section for review and approval by owner and architect.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver exterior plants freshly dug.

1. 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 except as approved by Architect. Protect bark, branches, and root systems from sun scald, drying, 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 exterior plants during delivery. Do not drop exterior plants during delivery and handling.
- C. Handle planting stock by root ball.
- D. Deliver exterior plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set exterior plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.
 1. Heel-in bare-root stock. Soak roots that are in dry condition in water for two hours. Reject dried-out plants.
 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 3. Do not remove container-grown stock from containers before time of planting.
 4. Water root systems of exterior plants stored on-site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

1.7 PROJECT CONDITIONS

- A. Planting Restrictions: Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed according to manufacturer's written instructions and warranty requirements. Do not plant or prepare soil during wet or saturated conditions. If rain is forecast, contractor to take the necessary measures to protect and cover work areas.
- C. Coordination with Lawns: Plant trees and shrubs after finish grades are established and before planting lawns unless otherwise acceptable to Architect.
 1. When planting trees and shrubs after lawns, protect lawn areas and promptly repair damage caused by planting operations.

1.8 WARRANTY

- A. Special Warranty: Installer's standard form in which 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 lack of adequate maintenance, neglect, abuse by Owner, or incidents that are beyond Contractor's control.
 - b. Structural failures including plantings falling or blowing over.
 - c. Faulty operation of tree stabilization, edgings, and tree grates.

- d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
2. Warranty Periods from Date of Substantial Completion:
 - a. Trees and Shrubs: One year.
 - b. Ground Cover and Plants: One year.
3. Include the following remedial actions as a minimum:
 - a. Remove dead exterior plants immediately. Replace immediately unless required to plant in the succeeding planting season.
 - b. Replace exterior plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
 - c. A limit of one replacement of each exterior plant will be required except for losses or replacements due to failure to comply with requirements.
 - d. Provide extended warranty for replaced plant materials; warranty period equal to original warranty period.

1.9 MAINTENANCE SERVICE

- A. Initial Maintenance Service for Trees and Shrubs: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.
 1. Maintenance Period: Until date of Substantial Completion.
- B. Initial Maintenance Service for Ground Cover and Plants: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below.
 1. Maintenance Period: Until date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TREE AND SHRUB MATERIAL

- A. General: Furnish nursery-grown trees and shrubs complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Provide trees and shrubs of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

- D. Label each tree and shrub with securely attached, waterproof tag bearing legible designation of botanical and common name.
- E. Label at least one tree and one shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.
- F. If formal arrangements or consecutive order of trees or shrubs is shown, select stock for uniform height and spread, and number label to assure symmetry in planting.

2.2 SHADE AND FLOWERING TREES

- A. Type 1 and Type 2 (Slower Growth) Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1 for type of trees required.
 - 1. Provide balled and burlapped trees.
 - 2. Branching Height: One-half of tree height.
- B. Small Upright Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:
 - 1. Stem Form: Single trunk or Multi-trunk clump as indicated.
 - 2. Provide balled and burlapped.
- C. Small Spreading Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:
 - 1. Stem Form: Multi-stem or Clump as indicated.
 - 2. Provide balled and burlapped trees.

2.3 DECIDUOUS SHRUBS

- A. Form and Size: Shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
 - 1. Shrub sizes indicated are sizes after pruning.
 - 2. Provide balled and burlapped or container-grown shrubs as indicated.

2.4 CONIFEROUS EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.
- B. Form and Size: Specimen quality as described, symmetrically shaped coniferous evergreens.
 - 1. Shearing Designation: Semi-sheared or lightly sheared (LS).
 - 2. Provide balled and burlapped trees.

2.5 BROADLEAF EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, complying with ANSI Z60.1.
- B. Form and Size: Specimen quality as described, symmetrically shaped broadleaf evergreens.
 - 1. Shearing Designation: Semi-sheared or lightly sheared (LS).
 - 2. Provide balled and burlapped trees.

2.6 PLANTS

- A. 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.
- B. Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed, complying with requirements in ANSI Z60.1.
- C. Vines: Provide vines of species indicated complying with requirements in ANSI Z60.1 as follows:
 - 1. Two-year plants with heavy, well-branched tops, with not less than 3 runners 18 inches (450 mm) or more in length, and with a vigorous well-developed root system.
 - 2. Provide field-grown vines. Vines grown in pots or other containers of adequate size and acclimated to outside conditions will also be acceptable.

2.7 TOPSOIL

- A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 4 percent organic material content; free of stones 1 inch (25 mm) or larger in any dimension and other extraneous materials harmful to plant growth.
 - 1. Topsoil Source: Import screened topsoil mix from off-site sources. Topsoil to be 50/50 blend with 20% Stalite fines mixed in as supplied by Triangle Landscape Supply or approved equal.

2.8 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural limestone 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.

2.9 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 3/4-inch (19-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:
 - 1. Organic Matter Content: 50 to 60 percent of dry weight.
 - 2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- B. Peat: Sphagnum peat moss, partially decomposed, finely divided or granular texture, with a pH range of 3.4 to 4.8.
- C. 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, and material harmful to plant growth.

2.10 FERTILIZER

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
 - 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.11 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
 - 1. Type: Shredded hardwood or Ground or shredded bark.

2.12 TREE STABILIZATION MATERIALS

- A. Stakes and Guys:
 - 1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.
 - 2. Guys and Tie Wires: 'Arbor Tie' or equivalent strapping.

3. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

B. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.
3. Proprietary Devices: Proprietary at- or below-grade stabilization system to secure each new planting by root ball; sized as indicated and per manufacturer's written recommendations.
 - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Border Concepts, Inc.; Tomahawk Tree Stabilizers.
 - 2) Foresight Products, LLC; Duckbill Rootball Fixing System.
 - 3) Tree Staple, Inc.; Tree Staples.

2.13 LANDSCAPE EDGINGS

A. Steel Edging: Standard commercial-steel edging, rolled edge, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.

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 indicated on Drawings or comparable product by one of the following:
 - a. Border Concepts, Inc.
 - b. Collier Metal Specialties, Inc.
 - c. Russell, J. D. Company (The).
 - d. Sure-Loc Edging Corporation.
3. Edging Size: 3/16 inch (4.8 mm) wide by 4 inches (100 mm) deep 1/8 inch (3.2 mm) wide by 4 inches (100 mm) deep.
4. Stakes: Tapered steel, a minimum of 15 inches (380 mm).
5. Accessories: Standard tapered ends, corners, and splicers painted.
6. Finish: Galvanized & painted.
7. Paint color: Brown

2.14 MISCELLANEOUS PRODUCTS

- A. Trunk-Wrap Tape: Two layers of crinkled paper cemented together with bituminous material, 4-inch- (100-mm-) wide minimum, with stretch factor of 33 percent.
- B. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with ASTM D 448 for Size No. 8.

2.15 PLANTING SOIL MIX

- A. Planting Soil Mix: Mix topsoil with the soil amendments and fertilizers at rates indicated by soil analysis. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas to receive exterior plants for compliance with requirements and conditions affecting installation and performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by planting operations.
- B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before planting. Make minor adjustments as required.
- D. Trunk Wrapping: Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping. Wrap trees of 2-inch (50-mm) caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling.
- E. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

3.3 PLANTING BED ESTABLISHMENT

- A. Entire shrub and groundcover beds to be prepared as follows: Loosen subgrade of planting beds to a minimum depth of 12 inches (150 mm). Remove stones larger than 1 inch (25 mm) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
 - 1. Apply fertilizer directly to subgrade before loosening.
 - 2. Thoroughly blend planting soil mix off-site before spreading.
 - a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
 - b. Mix lime with dry soil before mixing fertilizer.

3. Spread planting soil mix to a depth of 12 inches (200 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.
 - a. Spread approximately one-half the thickness of planting soil mix over loosened subgrade. Mix thoroughly into top 4 inches (100 mm) of subgrade. Spread remainder of planting soil mix.
- B. Finish Grading: Grade planting beds to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- C. Before planting, restore planting beds if eroded or otherwise disturbed after finish grading.

3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Pits and Trenches: Excavate circular pits with sides sloped inward. Trim base leaving center area raised slightly to support root ball and assist in drainage. Do not further disturb base. Scarify sides of plant pit smeared or smoothed during excavation.
 1. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
 2. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 3. If drain tile is shown or required under planted areas, excavate to top of porous backfill over tile.
- B. Subsoil removed from excavations may not be used as backfill.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.

3.5 TREE AND SHRUB PLANTING

- A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.
- B. Set balled and burlapped stock plumb and in center of pit or trench with top of root ball $\frac{1}{2}$ the rootball depth above adjacent finish grades.
 1. Remove burlap and wire baskets from tops of root balls and partially 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.
 2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.
- C. Set stock plumb and in center of pit or trench with top of root ball $\frac{1}{2}$ the rootball depth above adjacent finish grades.

1. Carefully remove root ball from container without damaging root ball or plant.
2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

- D. Organic Mulching: Apply 3-inch (75-mm) average thickness of organic mulch extending 12 inches (300 mm) beyond edge of planting pit or trench. Do not place mulch within 3 inches (75-mm) of trunks or stems.
- E. Inspect tree trunks for injury, improper pruning, and insect infestation; take corrective measures required before wrapping. Wrap trees of 2-inch (50-mm) caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling.

3.6 TREE AND SHRUB PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.

3.7 TREE STABILIZATION

- A. Trunk Stabilization: Unless otherwise indicated, provide trunk stabilization as follows:
- B. Guying and Staking: Guy and stake all trees as indicated. Securely attach no fewer than 3 guys to stakes 30 inches (760 mm) long, driven to grade

3.8 GROUND COVER AND PLANT PLANTING

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

3.9 PLANTING BED 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).
1. Material and Seam Treatment: Polyethylene sheeting with seams taped Nonwoven fabric with seams pinned or Composite fabric with seams pinned.
- B. Mulch backfilled surfaces of planting beds and other areas indicated. Provide mulch ring around trees in lawn areas.

1. Organic Mulch: Apply 3-inch (75-mm) average thickness of organic mulch, and finish level with adjacent finish grades. Do not place mulch against plant stems.

3.10 EDGING INSTALLATION

- A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches (760 mm) apart, driven below top elevation of edging.

3.11 PLANT MAINTENANCE

- A. Tree and Shrub Maintenance: Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, restoring planting saucers, adjusting and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease. Restore or replace damaged tree wrappings.
- B. Ground Cover and Plant Maintenance: Maintain and establish plantings by watering, weeding, fertilizing, mulching, and other operations as required to establish healthy, viable plantings.

3.12 CLEANUP AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect exterior plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

3.13 DISPOSAL

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 32 93 00

