

## SECTION 321216 - ASPHALT PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Cold milling of existing hot-mix asphalt pavement.
  - 2. Hot-mix asphalt patching.
  - 3. Hot-mix asphalt paving.
  - 4. Hot-mix asphalt paving overlay.
  - 5. Pavement-marking.
  - 6. Wheel stops.
  - 7. Traffic-calming devices.
  - 8. Imprinted asphalt.

#### 1.3 DEFINITION

- A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

#### 1.4 SUBMITTALS

- A. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
  - 1. Each pattern and color of imprinted asphalt.
- B. Material Test Reports: For each paving material.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Imprinted-asphalt manufacturer's authorized installer who is trained and approved for installation of imprinted asphalt required for this Project.
- B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the South Carolina Department of Transportation for asphalt paving work.
  - 1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
  - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
  - b. Review condition of subgrade and preparatory work.
  - c. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
  - d. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

D. Authorities Having Jurisdiction: Conform to requirements of all authorities having jurisdiction.

1. Where conflicts exist between the requirements of the Contract Documents and those of authorities having jurisdiction, the higher quality or more restrictive requirement shall apply.
  - a. For locations within areas of DOT jurisdiction, perform all work, testing, and inspections in accordance with applicable DOT standards and procedures.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

#### 1.7 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
  1. Where Work activities encroach into public rights-of-way, provide traffic control to maintain safe transit of work area by vehicular and pedestrian traffic.
    - a. All traffic control shall be in accordance with the requirements of the authorities having jurisdiction.
- B. Environmental Limitations: Do not apply asphalt materials if subgrade is frozen, wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
  1. During the months of December, January and February except with the written permission of the Architect.
  2. Lift thickness of 1.0" or less: Min surface temp: 55 deg F and rising at time of placement.
  3. Lift thickness of 1.1" to 2.0": Min surface temp: 45 deg F and rising at time of placement.
  4. Lift thickness of 2.1" to 3.0": Min surface temp: 40 deg F and rising at time of placement.
  5. Lift thickness of 3.1" to 4.5": Min surface temp: 35 deg F and rising at time of placement.
- C. Pavement-Marking: Proceed with pavement marking only on clean, dry surfaces; at a minimum ambient or surface temperature of at least 55 deg F, and not exceeding 95 deg F; and at a maximum relative of

85%. Do not apply pavement markings if rain is imminent or expected before time required for adequate drying.

- D. Imprinted Asphalt Paving: Proceed with coating imprinted pavement only when air temperature is at least 50 deg F and rising and will not drop below 50 deg F within 8 hours of coating application. Proceed only if no precipitation is expected within two hours after applying the final layer of coating.

## PART 2 - PRODUCTS

### 2.1 ASPHALT PAVING MIXES

- A. Base Course: Type A Hot Mix Asphalt Aggregate Base Course in accordance with Sections 310 and 401 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.
- B. Prime/Tack Coat: Asphalt binder or emulsified asphalt in accordance with Section 401 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.
- C. Intermediate (Binder) Course: Type B Hot Mix Asphalt Intermediate Course in accordance with Sections 401 and 402 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.
- D. Asphalt Surface Course: Type B or C (as indicated) Hot Mix Asphalt Surface Course in accordance with Sections 401 and 403 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.

### 2.2 AUXILIARY MATERIALS

- A. Joint Sealant: ASTM D 6690, Type II, hot-applied, single-component, polymer-modified bituminous sealant.

### 2.3 PAVEMENT MARKINGS

- A. Pavement-Marking Paint: Reflectorized, heavy metals free, fast drying, waterborne paint for pavement markings in accordance with Section 625 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.
  - 1. Color: As indicated.
  - 2. Glass Beads: AASHTO M 247, Type 1.
- B. Thermoplastic Pavement Markings: Reflectorized mixture of thermoplastic binder and spherical glass beads in accordance with Section 627 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.
  - 1. Color: As indicated.
  - 2. Glass Beads: AASHTO M 247, Type 1.

## 2.4 WHEEL STOPS

- A. Wheel Stops: Precast, air-entrained concrete, 2500-psi minimum compressive strength, 5 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.
  - 1. Dowels: Galvanized steel, diameter 1/8" smaller than anchor holes provided in wheel stop, 24-inch minimum length.

## 2.5 IMPRINTED ASPHALT MATERIALS

- A. Templates: Imprinted-asphalt manufacturer's standard flexible templates for imprinting pattern into hot asphalt paving.
  - 1. Pattern: Indicated on Drawings.
- B. Coating System: Imprinted-asphalt manufacturer's standard system formulated for exterior application on asphalt paving surfaces.
  - 1. Top Coating: Epoxy-modified acrylic polymer blended with sand and aggregate, formulated for exterior application on asphalt paving surfaces.
  - 2. Colorant: UV-stable pigment blend, added to each coating layer.
  - 3. Color: As chosen by Architect from manufacturer's full range.
- C. Coating System: Imprinted-asphalt manufacturer's thermoplastic system formulated for exterior application on asphalt paving surfaces.
  - 1. Top Coating: Aggregate-reinforced thermoplastic, formulated for exterior application on asphalt paving surfaces.
  - 2. Thickness: 150 mils
  - 3. Colorant: UV-stable pigment blend, post applied to thermoplastic coating.
  - 4. Color: As chosen by Architect from manufacturer's full range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that the subgrade or base course, as applicable, has been installed in accordance with the requirements of Division 31 Section "Earth Moving", and that its dry and in suitable condition to begin paving.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
  - 2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
  - 3. 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. Proceed with paving only after unsatisfactory conditions have been corrected.

- D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

### 3.2 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
  - 1. Mill to a depth required to establish new grade but in no case less than the indicated new asphalt surface course thickness.
  - 2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
  - 3. Control rate of milling to prevent tearing of existing asphalt course.
  - 4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
  - 5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
  - 6. Transport milled asphalt to asphalt recycling facility.
  - 7. Keep milled pavement surface free of loose material and dust.

### 3.3 PATCHING

- A. Hot-Mix Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- C. Patching: Fill excavated pavements with hot-mix asphalt surface course, in lifts not to exceed 3 inches thick, and compact each lift while still hot. Compact final lift flush with adjacent surface.

### 3.4 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
  - 1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of 1/4 inch.
  - 1. Clean cracks and joints in existing hot-mix asphalt pavement.
  - 2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
  - 3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

### 3.5 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade or base course, as applicable, is ready to receive paving.
- B. Prime Coat: Apply uniformly over surface of compacted graded-aggregate base course at the rates indicated below. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.
  - 1. Apply to macadam base course at a rate of 0.25 to 0.30 gal./sq. yd.
  - 2. Apply to marine limestone base course at a rate of 0.10 to 0.15 gal./sq. yd.
  - 3. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
  - 4. Protect primed substrate from damage until ready to receive paving.
- C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
  - 1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  - 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.6 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
  - 1. Place hot-mix asphalt aggregate base course to the total thicknesses indicated in lifts not to exceed 6 inches in thickness.
  - 2. Place hot-mix asphalt intermediate (binder) course to the total thicknesses indicated in lifts not to exceed 4 inches in thickness.
  - 3. Place hot-mix asphalt surface course to the total thicknesses indicated in lifts not to exceed 3 inches in thickness.
  - 4. Spread mix at temperature of not less than 250 deg F nor more than 325 deg F.
  - 5. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
  - 6. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in a minimum number of equal width consecutive strips, up to a maximum width of 12 feet for each strip.
  - 1. Adjust width and number of strips as necessary to provide the minimum number while maintaining requirement for longitudinal joint spacing of successive courses as indicated below. Make adjustments in lower courses such that the top course will be applied using the minimum possible number of strips.
  - 2. The width of each strip of the top course shall equal the width of the travel lane unless otherwise indicated.
  - 3. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of each asphalt course before beginning a succeeding course.

- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.7 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
  - 1. Clean contact surfaces and apply tack coat to joints.
  - 2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
  - 3. Offset transverse joints, in successive courses, a minimum of 24 inches.
  - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
  - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
  - 6. Compact asphalt at joints to a density within 2 percent of specified course density.

### 3.8 COMPACTION

- A. General: Begin compaction, starting at outside edges and joints, as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
  - 1. Complete compaction before mix temperature cools to 185 deg F.
  - 2. Roll with an 8 to 12 ton tandem steel-wheel roller conforming to the requirements of Section 401 of the South Carolina Department of Transportation Standard Specifications for Highway Construction
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
  - 1. Average Density: between 98% and 102% of the target density established in accordance with SCDOT Specification SC-T-65.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.9 ASPHALT TRAFFIC-CALMING DEVICES

- A. Construct hot-mix asphalt speed humps over compacted pavement surfaces. Apply a tack coat unless pavement surface is still tacky and free from dust. Spread mix at minimum temperature of 250 deg F.
  - 1. Tack Coat Application: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
  - 2. Asphalt Mix: Same as pavement surface-course mix.
- B. Place hot-mix asphalt to cross section indicated, by machine or by hand. Tamp hand-placed materials and screed to smooth finish.

### 3.10 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  - 1. Base Course: Plus or minus 1/2 inch.
  - 2. Intermediate (Binder) Course: Plus or minus 1/4 inch.
  - 3. Surface Course: Plus 1/4 inch, no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: 1/4 inch.
  - 2. Intermediate (Binder) Course: 1/4 inch.
  - 3. Surface Course: 1/8 inch.
  - 4. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

### 3.11 PAVEMENT MARKING

- A. Do not apply pavement-markings until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for 30 days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Surface shall be dry and free of glaze, oil, dirt, grease or other foreign contaminants.
- E. Apply paint with mechanical equipment for the application of waterborne asphalt paint meeting the requirements of Section 625 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.
  - 1. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
  - 2. Broadcast glass beads uniformly into wet pavement markings at a rate of 6 lb/gal.
- F. Apply thermoplastic pavement markings with mechanical equipment for the application of thermoplastic pavement markings meeting the requirements of Section 627 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.



1. Apply at manufacturer's recommended rates to provide a finished thickness of 90 mils.
2. Glass beads shall be mechanically applied to the surface of the thermoplastic material immediately after it is applied to the pavement surface and while it is still molten. Uniformly apply at a rate of 12 lb per 100 sq ft.

G. Apply to produce pavement markings of the dimensions indicated; which are straight or of uniform curvature; of consistent width; and with crisp, uniform, edges.

1. The finished line markings shall be free from waviness and the lateral deviations shall not exceed 2 inches in 15 feet.
2. No markings shall be less than the specified width.

### 3.12 WHEEL STOPS

A. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

### 3.13 IMPRINTING ASPHALT

A. General: Imprint asphalt according to manufacturer's written instructions, using manufacturer's recommended equipment.

B. Reheating Asphalt: Soften asphalt pavement surface by heating to a depth of at least 1/2 inch without burning asphalt.

1. Heat to a temperature of 300 to 325 deg F immediately before applying templates.
2. Regularly monitor the pavement temperature to prevent overheating.
3. Direct flame heaters are not permitted.
4. If pavement is overheated and begins to emit black smoke, remove damaged pavement by milling down 1 inch and replace removed pavement with new, compacted surface course prior to resuming imprinting work.

C. Surface Imprinting: Apply and imprint templates to a minimum depth of 1/4 inch or as required to embed precut marking material flush or barely beneath pavement surface.

D. Coating Application: After imprinted surface is complete, apply thermoplastic texture coating and heat until fused with asphalt substrate. Once thermoplastic has completely cooled and cured, sand and apply top coating. Do not allow traffic until coating has completely dried and cured.

### 3.14 FIELD QUALITY CONTROL

A. Testing Agency: Contractual responsibilities for testing are identified in Division 1 Section "Quality Requirements". Responsible party will engage a qualified independent testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined by core samples in accordance with SCDOT Specification SC-T-100.

1. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 samples taken, except for locations within areas of DOT jurisdiction which shall be sampled according to applicable DOT rates.
  2. Replace and compact hot-mix asphalt where core tests were taken.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with SCDOT Specifications SC-T-65 and SC-T-100.
1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to SCDOT Specification SC-T-65, and compacted according to job-mix specifications.
  2. In-place density of compacted pavement will be determined by nuclear gauge in accordance with SCDOT Specifications SC-T-65, SC-T-68 and SC-T-100, as applicable.
    - a. One test will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 tests taken, except for locations within areas of DOT jurisdiction which shall be tested according to applicable DOT rates.
- E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### 3.15 DISPOSAL

- A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow milled materials to accumulate on-site.

### 3.16 PROTECTION

- A. Protect paving installations from deposition of sediments from adjoining grounds and vehicular traffic.
1. Install and maintain erosion control measures as necessary, at boundaries of paving installations, to prevent migration of sediment onto the pavement surface.
  2. Where practicable, erect and maintain barricades to prevent construction traffic on the paving surface.
  3. Do not allow tracking of mud or debris onto the pavement surface by any vehicle.
  4. If deposition of sediment on the paving surface is noted, remove and clean pavement surface immediately. Do not delay cleaning efforts as subsequent rainfall events may worsen potential damage.

END OF SECTION 321216

## SECTION 321313 - CONCRETE PAVING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes exterior cement concrete pavement for the following:
  - 1. Curbs and gutters.
  - 2. Walkways.
  - 3. Equipment slabs on grade.
  - 4. Unit paver base.
  - 5. Pavement markings.

#### 1.3 SUBMITTALS

- A. Sample: 2-lb sample of Oyster shell.
- B. Field quality-control test reports.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with the equipment, material and production requirements of Section 701 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.
- B. Concrete Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 and ASTM C 1077 to perform material evaluation tests and to design concrete mixtures.
- C. Mockups: Cast mockups of full-size sections of integrally colored, tabby concrete pavement to demonstrate typical joints, surface finish, texture, color, and standard of workmanship.
  - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
  - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  - 3. Obtain Architect's approval of mockups before starting construction.
  - 4. Maintain approved mockups during construction in an undisturbed condition as a standard for judging the completed pavement.
  - 5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:
  - a. Contractor's superintendent.
  - b. Independent testing agency responsible for concrete design mixtures.
  - c. Ready-mix concrete producer.
  - d. Concrete pavement subcontractor.

E. Authorities Having Jurisdiction: Conform to requirements of all authorities having jurisdiction.

1. Where conflicts exist between the requirements of the Contract Documents and those of authorities having jurisdiction, the higher quality or more restrictive requirement shall apply.
  - a. For locations within areas of DOT jurisdiction, perform all work, testing, and inspections in accordance with applicable DOT standards and procedures.

## 1.5 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
  1. Where Work activities encroach into public rights-of-way, provide traffic control to maintain safe transit of work area by vehicular and pedestrian traffic.
    - a. All traffic control shall be in accordance with the requirements of the authorities having jurisdiction.
- B. Environmental Limitations: Do not install concrete paving if subgrade is frozen, wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the ambient air temperature is below, or is expected to fall below, 40 deg F during the time of placement.

## PART 2 - PRODUCTS

### 2.1 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
  1. Use flexible or curved forms for curves as necessary in order to prevent a chord effect in the alignment of the finished work.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

### 2.2 STEEL REINFORCEMENT

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

- B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.
- C. Plain Steel Wire: ASTM A 82, as drawn.
- D. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- E. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
- F. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
  - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
  - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- H. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.
- I. Zinc Repair Material: ASTM A 780.

## 2.3 CONCRETE MATERIALS

- A. Concrete: Class 3000 or 4000 concrete, as indicated, in accordance with Section 701 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.
- B. Water: ASTM C 94/C 94M.
- C. Admixtures: Air-entraining, accelerating, retarding, and water reducing admixtures shall be in accordance with Section 701 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.

## 2.4 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
  - 1. Products:

- a. Axim Concrete Technologies; Cimfilm.
- b. Burke by Edeco; BurkeFilm.
- c. ChemMasters; Spray-Film.
- d. Conspec Marketing & Manufacturing Co., Inc.; Aquafilm.
- e. Dayton Superior Corporation; Sure Film.
- f. Euclid Chemical Company (The); Eucobar.
- g. Kaufman Products, Inc.; Vapor Aid.
- h. Lambert Corporation; Lambco Skin.
- i. L&M Construction Chemicals, Inc.; E-Con.
- j. MBT Protection and Repair, ChemRex Inc.; Confilm.
- k. Meadows, W. R., Inc.; Sealtight Evapre.
- l. Metalcrete Industries; Waterhold.
- m. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
- n. Sika Corporation, Inc.; SikaFilm.
- o. Symons Corporation; Finishing Aid.

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

1. Products:

- a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
- b. Burke by Edoko; Aqua Resin Cure.
- c. ChemMasters; Safe-Cure Clear.
- d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
- e. Dayton Superior Corporation; Day Chem Rez Cure (J-11-W).
- f. Euclid Chemical Company (The); Kurez DR VOX.
- g. Kaufman Products, Inc.; Thinfilm 420.
- h. Lambert Corporation; Aqua Kure-Clear.
- i. L&M Construction Chemicals, Inc.; L&M Cure R.
- j. Meadows, W. R., Inc.; 1100 Clear.
- k. Nox-Crete Products Group, Kinsman Corporation; Resin Cure E.
- l. Symons Corporation; Resi-Chem Clear.
- m. Tamms Industries Inc.; Horncure WB 30.

F. White Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 2, Class B.

1. Products:

- a. Anti-Hydro International, Inc.; AH Curing Compound #2 WP WB.
- b. Burke by Edoco; Resin Emulsion White.
- c. ChemMasters; Safe-Cure 2000.
- d. Conspec Marketing & Manufacturing Co., Inc.; W.B. Resin Cure.
- e. Dayton Superior Corporation; Day-Chem White Pigmented Cure (J-10-W).
- f. Euclid Chemical Company (The); Kurez VOX White Pigmented.
- g. Kaufman Products, Inc.; Thinfilm 450.
- h. Lambert Corporation; Aqua Kure-White.
- i. L&M Construction Chemicals, Inc.; L&M Cure R-2.
- j. Meadows, W. R., Inc.; 1200-White.
- k. Symons Corporation; Resi-Chem White.
- l. Tamms Industries, Inc.; Horncure 200-W.

G. Special Curing Compound for Integrally Colored Concrete: ASTM C 309, water-based acyclic emulsion curing compound, formulated for use with integrally colored concrete.

1. Products: One of the following or equal:

CONCRETE PAVING

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- a. COLORCURE Concrete Sealer; L.M. Scofield Co.
- b. QC COLOR CURE; QC Construction Products.

## 2.5 RELATED MATERIALS

- A. Preformed Joint Filler: AASHTO M 153, preformed sponge rubber expansion joint filler.
  - 1. Use only materials manufactured from rubber.
  - 2. Use materials that require a load of not less than 340 kPa or greater than 5,200kPa to compress to 50% of its thickness when tested in accordance with AASHTO T 42.
  - 3. Use materials that have a recovery of at least 70% when tested in accordance with AASHTO T 42.
  - 4. For locations within areas of SCDOT jurisdiction, use only products that are listed on SCDOT Qualified Product List 81.
- B. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.
  - 1. Manufacturers:
    - a. Bayer Corporation.
    - b. ChemMasters.
    - c. Conspec Marketing & Manufacturing Co., Inc.
    - d. Davis Colors.
    - e. Lambert Corporation.
    - f. QC Construction Products.
    - g. Scofield, L. M. Company.
    - h. Solomon Colors.
  - 2. Color: As selected by Architect from manufacturer's full range.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to requirements, and as follows:
  - 1. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Chemical Surface Retarder: Water-soluble, liquid-set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.
  - 1. Products:
    - a. Burke by Edeco; True Etch Surface Retarder.
    - b. ChemMasters; Exposee.
    - c. Conspec Marketing & Manufacturing Co., Inc.; Delay S.
    - d. Euclid Chemical Company (The); Surface Retarder S.
    - e. Kaufman Products, Inc.; Expose.
    - f. Metalcrete Industries; Surfard.
    - g. Nox-Crete Products Group, Kinsman Corporation; Crete-Nox TA.
    - h. Scofield, L. M. Company; Lithotex.

i. Sika Corporation, Inc.; Rugasol-S.

F. Oyster Shell for Tabby Finish: No. 3 size gradation.

## 2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to Section 701 of the South Carolina Department of Transportation Standard Specifications for Highway Construction, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete mixture designs for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 3000 or 4000 psi, as indicated.

2. Maximum Water-Cementitious Materials Ratio at Point of Placement: in accordance with Section 701 of the South Carolina Department of Transportation Standard Specifications for Highway Construction.

3. Slump Limit: 5 inches, plus or minus 1 inch, except where lower slump is required for automatic machine placement or other specialized applications.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 6 percent plus or minus 1.5 percent for 3/4-inch nominal maximum aggregate size

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

E. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to the requirements of Section 701 of the South Carolina Department of Transportation Standard Specifications for Highway Construction as follows:

1. Fly Ash: 20 percent.

2. Ground Granulated Blast-Furnace Slag: 50 percent.

F. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

## 2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to Sections 501 and 701 of the South Carolina Department of Transportation Standard Specifications for Highway Construction. Furnish batch certificates for each batch discharged and used in the Work.

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



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. For concrete curb and gutter and pavements to be subjected to vehicular traffic, proof-roll prepared subbase surface with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding.
  - 1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph.
  - 2. Proof-roll with a loaded 10-wheel tandem-axle dump truck weighing not less than 15 tons.
  - 3. Subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch require correction according to requirements in Section titled "Earth Moving."
- C. Proceed with concrete pavement operations only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.

### 3.2 PREPARATION

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

### 3.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

### 3.4 STEEL REINFORCEMENT

- A. General: Comply with Sections 501 and 703 of the South Carolina Department of Transportation Standard Specifications for Highway Construction and CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

### 3.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.
  2. For locations within areas of DOT jurisdiction, perform all work, testing, and inspections in accordance with applicable DOT standards and procedures.
- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.
1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
  2. Provide tie bars at sides of pavement strips where indicated.
  3. Butt Joints: Use bonding agent or epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
1. Unless otherwise indicated, joints shall be 3/4 inch in width.
  2. Locate expansion joints at intervals of 100 feet, unless otherwise indicated.
  3. Extend joint fillers full width and depth of joint.
  4. Place top of joint filler flush with finished concrete surface.
  5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
  6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction (Control) Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/2-inch radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces unless indicated to remain.
  2. Spacing in Pavements: Unless otherwise indicated, locate as follows:
    - a. Locate transverse contraction joints at intervals twice the width of the pavement, not to exceed 10 feet.
    - b. Where the pavement width exceeds 10 feet to a maximum of 24 feet, locate a longitudinal contraction joint along the centerline of the pavement.
    - c. Where the pavement width exceeds 24 feet, locate longitudinal contraction joints at evenly spaced divisions not to exceed 10 feet.

3. Spacing in Curb: Unless otherwise indicated, locate contraction joints to coincide with the adjoining concrete pavement or, where an adjoining concrete pavement does not exist, at an interval of 10 feet.
- E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/2-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces unless indicated to remain.

### 3.6 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with the requirements of Sections 501, 701, and 720 of the South Carolina Department of Transportation Standard Specifications for Highway Construction for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to Sections 501 and 720 of the South Carolina Department of Transportation Standard Specifications for Highway Construction by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
  1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.
- H. Screed pavement surfaces with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- K. Slip-Form Pavers: When automatic machine placement is used for pavement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce pavement to required thickness, lines, grades, finish, and jointing as required for formed pavement.

1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of paver machine during operations.
- L. When adjoining pavement lanes are placed in separate pours, do not operate concrete installation equipment on placed concrete until it has attained 85 percent of its 28-day compressive strength.
- M. Cold-Weather Placement: Comply with Sections 501, 701, and 702 of the South Carolina Department of Transportation Standard Specifications for Highway Construction and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. Concrete operations shall not be undertaken when air temperature has fallen to or is expected to fall below 40 deg F.
  2. Do not use frozen materials or materials containing ice or snow.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mix designs.
- N. Hot-Weather Placement: Comply with Sections 501, 701, and 702 of the South Carolina Department of Transportation Standard Specifications for Highway Construction and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

### 3.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
1. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

### 3.8 SPECIAL FINISHES

- A. Tabby Finish: Immediately after floating, broadcast a single layer of oyster shell uniformly onto the concrete surface. Tamp seeded shell into plastic concrete to entirely embed shell with mortar cover of 1/16 inch.
1. Spray-apply chemical surface retarder to concrete according to manufacturer's written instructions.
  2. Cover concrete surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.

3. Without dislodging aggregate, remove excess mortar by lightly brushing surface with a stiff, nylon bristle broom.
4. Fine-spray surface with water and brush. Repeat water flushing and brushing cycle until cement film is removed from aggregate surfaces to depth required.

### 3.9 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with Sections 501, 701, and 702 of the South Carolina Department of Transportation Standard Specifications for Highway Construction for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
  1. Moist Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

### 3.10 PAVEMENT TOLERANCES

- A. Comply with tolerances of Section 501 of the South Carolina Department of Transportation Standard Specifications for Highway Construction and as follows:
  1. Elevation: 1/4 inch.
  2. Thickness: Plus 3/8 inch, minus 1/4 inch.
  3. Surface: Gap below 10-foot- long, unlevelled straightedge not to exceed 1/4 inch.
  4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
  5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
  6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch.
  7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches.
  8. Joint Spacing: 3 inches.

9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

### 3.11 FIELD QUALITY CONTROL

- A. Testing Agency: Contractual responsibilities for testing are identified in Division 1 Section "Quality Requirements". Responsible party will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day, except for locations within areas of DOT jurisdiction which shall be sampled according to applicable DOT rates.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
  3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
  4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
  5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
  6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2 specimens at 28 days.
    - a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

- G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.12 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude vehicular traffic from pavement for at least 7 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

## 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 mortar setting beds.
  - 2. Concrete edge restraints

#### 1.3 SUBMITTALS

- A. Product Data: For materials other than water and aggregates.
- B. Samples for Verification:
  - 1. Full-size units of each type of unit paver indicated.
  - 2. Joint materials.
  - 3. Exposed edge restraints.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified unit paving installer meeting the following qualifications.
  - 1. Experience: Five years' experience in unit paving installation in addition to requirements in Division 01 Section "Quality Requirements."
- B. 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.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
- D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
- E. Authorities Having Jurisdiction: Conform to requirements of all authorities having jurisdiction.
  - 1. Where conflicts exist between the requirements of the Contract Documents and those of authorities having jurisdiction, the higher quality or more restrictive requirement shall apply.



## 1.5 DELIVERY, STORAGE, AND HANDLING

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

## 1.6 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, base course, or setting beds. Remove and replace unit paver work damaged by frost or freezing.
- B. Install products during favorable weather conditions according to manufacturer's written instructions.
- C. Where practicable, delay installation of unit paving until as late as possible in the construction sequence to avoid potential damage by construction traffic.
- D. Implement and maintain protection measures, as indicated in the "Protection" article below, immediately after installation is complete.
- E. Weather Limitations for Mortar and Grout:
  - 1. Cold-Weather Requirements: Protect unit paver work against freezing when ambient temperature is 40 deg F and falling. Heat materials to provide mortar and grout temperatures between 40 and 120 deg F. 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, cover with weather-resistant membrane; below 25 deg F, cover with insulating blankets; below 20 deg F, provide enclosure and temporary heat to maintain temperature above 32 deg F.
  - 2. Hot-Weather Requirements: Protect unit paver work when temperature and humidity conditions produce excessive evaporation of setting beds and grout. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
    - a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set pavers within 1 minute of spreading setting-bed mortar.

## PART 2 - PRODUCTS

### 2.1 BRICK PAVERS

- A. Brick Pavers: Heavy vehicular paving brick; ASTM C 1272, Type R, Application PS. Provide brick without frogs or cores in surfaces exposed to view in the completed Work. Match Existing

1. Products: Subject to compliance with requirements, provide one of the following:

a. Match Existing

2. Thickness: Match Existing

3. Face Size: Match Existing

4. Length: Match Existing

5. Color: Match Existing

B. Efflorescence: Brick shall be rated "not effloresced" when tested according to ASTM C 67. Match Existing.

## 2.2 ACCESSORIES

A. Job-Built Concrete Edge Restraints: Comply with requirements in Division 32 Section "Concrete Paving" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi.

## 2.3 MORTAR SETTING-BED MATERIALS

A. Portland Cement: ASTM C 150, Type I or II.

B. Sand: ASTM C 144.

C. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

a. Boiardi Products Corporation.

b. Bonsal, W. R. Company.

c. Bostik Findley Inc.

d. C-Cure.

e. Custom Building Products.

f. DAP Inc.

g. Jamo Inc.

h. Laticrete International, Inc.

i. MAPEI Corp.

j. SGM.

k. Summitville Tiles, Inc.

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

D. Water: Potable.

## 2.4 GROUT MATERIALS

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

1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products Corporation.
    - b. Bonsal, W. R. Company.
    - c. Bostik Findley Inc.
    - d. C-Cure.
    - e. Custom Building Products.
    - f. DAP Inc.
    - g. Jamo Inc.
    - h. Laticrete International, Inc.
    - i. MAPEI Corp.
    - j. SGM.
    - k. Summitville Tiles, Inc.
    - l. TEC Incorporated; H. B. Fuller Company.
  2. Product Type: Dry mix, containing ethylene vinyl acetate, in dry, redispersible form, prepackaged with other dry ingredients.
- B. Grout Colors: As selected by Architect from manufacturer's full range.
- C. Water: Potable.

## 2.5 MORTAR 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.

## 2.6 GROUT MIXES

- A. Packaged, Polymer-Modified Grout Mix: Proportion and mix grout ingredients according to grout manufacturer's 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. Where applicable, 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. Confirm that base course has been prepared and tested according to requirements in Division 31 Section "Earth Moving". Confirm that damage or degradation to base course has not occurred since testing was completed. Proceed with unit paver installation only after deficient base course has been corrected and is ready to receive leveling course for unit pavers.
- D. Confirm that job-built concrete edge restraints comply with requirements in Division 32 Section "Concrete Paving".

### 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. Pavers over Waterproofing (where applicable): Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with paving.
  1. Where applicable, provide joint filler at waterproofing that is turned up on vertical surfaces, unless otherwise indicated; where unfilled joints are indicated, provide temporary filler or protection until paver installation is complete.
- G. Tolerances: Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.
- H. Expansion and Control Joints: Provide joint filler at locations and of widths indicated. Install joint filler before setting pavers.

- I. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.
  1. Install Job-Built Concrete Edge Restraints as indicated on the Drawings and in accordance with the requirements of Division 32 Section "Concrete Paving".
  2. 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.
  3. For metal edge restraints with top edge exposed, drive stakes at least 1 inch below top edge.
  4. Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.
  5. Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install by embedding in accordance with manufacturer's written instructions. Allow concrete to cure before placing aggregate setting bed. Hold top of concrete below aggregate setting bed.
- J. Where applicable, 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. Where indicated, place separation geotextile over prepared subgrade, overlapping ends and edges at least 12 inches.
- B. Where indicated, place drainage geotextile over compacted base course, overlapping ends and edges at least 12 inches.
- C. Place leveling course and screed to thickness indicated, taking care that moisture content remains constant and density is loose and constant until pavers are set and compacted.
- D. Treat leveling course with herbicide to inhibit growth of grass and weeds.
- E. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers.
  1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- F. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. Perform at least three passes across paving with vibrator. Vibrate under the following conditions:
  1. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.

2. Before ending each day's work, fully compact installed concrete pavers to within 36 inches of the laying face. Cover pavers that have not been compacted, and leveling course on which pavers have not been placed, with nonstaining plastic sheets to protect them from rain.
- G. 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.
- H. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- I. Repeat joint-filling process 30 days later.

### 3.5 MORTAR SETTING-BED APPLICATIONS

- A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing setting bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch 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. Place mortar bed with reinforcing wire fully embedded in middle of setting bed. Spread and screed setting bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
- E. 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.
- F. Wet brick pavers before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- G. Place pavers before initial set of cement occurs. Immediately before placing pavers on setting bed, apply uniform 1/16-inch- thick, slurry bond coat to bed or to back of each paver with a flat trowel.
- H. Tamp 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.
- I. Spaced Joint Widths: Provide joint widths as indicated with variations not exceeding plus or minus 1/16 inch.
- J. Grout joints as soon as possible after initial set of setting bed.
  1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
  2. 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.
- K. Cure grout by maintaining in a damp condition for seven days, unless otherwise recommended by grout or liquid-latex manufacturer.

### 3.6 REPAIRING

- 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.

### 3.7 POINTING, AND CLEANING

- A. 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.
- B. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.
1. Where applicable, 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.

### 3.8 PROTECTION

- A. Protect paving installations from deposition of sediments from adjoining grounds and vehicular traffic.
1. Install and maintain erosion control measures as necessary, at boundaries of paving installations, to prevent migration of sediment onto the pavement surface.
  2. Where practicable, erect and maintain barricades to prevent construction traffic on the paving surface.
  3. Do not allow tracking of mud or debris onto the pavement surface by any vehicle.
  4. If deposition of sediment on the paving surface is noted, remove and clean pavement surface immediately. Do not delay cleaning efforts as subsequent rainfall events may worsen potential damage.

END OF SECTION 321400

## SECTION 321410 – ADA DETECTABLE WARNING PAVERS

### 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. ADA detectable warning concrete pavers set in mortar setting beds.

#### 1.3 SUBMITTALS

- A. Product Data: For materials other than water and aggregates.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified unit paving installer meeting the following qualifications.
  - 1. Experience: Five years' experience in unit paving installation in addition to requirements in Division 01 Section "Quality Requirements."
  - 2. Installer's Field Supervision: Installer shall maintain supervisor on Project site full-time when work is in progress.
- B. 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.
- C. Regulatory Requirements: Comply with the requirements of the Americans with Disabilities Act and related regulations and guidelines.
- D. Authorities Having Jurisdiction: Conform to requirements of all authorities having jurisdiction.
  - 1. Where conflicts exist between the requirements of the Contract Documents and those of authorities having jurisdiction, the higher quality or more restrictive requirement shall apply.

#### 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 liquids in tightly closed containers protected from freezing.

## 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 Mortar:
  - 1. Cold-Weather Requirements: Protect unit paver work against freezing when ambient temperature is 40 deg F and falling. Heat materials to provide mortar temperatures between 40 and 120 deg F. 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, cover with weather-resistant membrane; below 25 deg F, cover with insulating blankets; below 20 deg F, provide enclosure and temporary heat to maintain temperature above 32 deg F.
  - 2. Hot-Weather Requirements: Protect unit paver work when temperature and humidity conditions produce excessive evaporation of setting beds. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
    - a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F, set pavers within 1 minute of spreading setting-bed mortar.

## PART 2 - PRODUCTS

### 2.1 ADA DETECTABLE WARNING PAVERS

- A. ADA Detectable Warning Concrete Pavers: Solid interlocking paving units complying with ASTM C 936 and resistant to freezing and thawing when tested according to ASTM C 67, made from normal-weight aggregates.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ADA Detectable Warning Pavers by ECG (Elizabeth City Glass), Inc. (These pavers are approved by SCDOT and therefore must be used for all work within an SCDOT R/W).
    - b. Hanover Detectable Warning Pavers by Hanover Architectural Products
    - c. Detectable Warning Pavers by Tile Tech Industries.
    - d. ADA Detectable Warning Pavers by Pavestone Company.
  - 2. Surface Texture: Non-slip, truncated dome surface texture meeting the requirements of the Americans with Disabilities Act (ADA).
  - 3. Thickness: From 1" to 4" depending on manufacturer.
  - 4. Face Size and Shape: Square or rectangular, depending on manufacture with no dimension larger than 11-3/4".
  - 5. Color: As selected by Architect from manufacturer's full range.

## 2.2 MORTAR SETTING-BED MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II.
- B. Sand: ASTM C 144.
- C. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement mortar bed, and not containing a retarder.
  - 1. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
    - a. Boiardi Products Corporation.
    - b. Bonsal, W. R. Company.
    - c. Bostik Findley Inc.
    - d. C-Cure.
    - e. Custom Building Products.
    - f. DAP Inc.
    - g. Jamo Inc.
    - h. Laticrete International, Inc.
    - i. MAPEI Corp.
    - j. SGM.
    - k. Summitville Tiles, Inc.
    - l. TEC Incorporated; H. B. Fuller Company.
- D. Water: Potable.

## 2.3 MORTAR 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.

## 2.4 AGGREGATE MATERIALS

- A. All sand and aggregate materials shall be free of shale, clay, friable material, debris, waste, frozen materials, vegetation, organic material, or other deleterious matter.

- B. Sand for Joints: Natural or manufactured sand in accordance with the gradation requirements for Fine Aggregate FA-10 (natural) or FA-10M (manufactured) as defined by the South Carolina Department of Transportation Standard Specifications for Highway Construction.
  - 1. Provide sand of color needed to produce required joint color.

### 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.

#### 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. Confirm that job-built concrete edge restraints comply with requirements in Division 32 Section "Concrete Paving."

#### 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. Joint Pattern: As indicated.
- E. Tolerances: Do not exceed 1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

#### 3.4 MORTAR SETTING-BED APPLICATIONS

- A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.

- B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing setting bed. Limit area of bond coat to avoid its drying out before placing setting bed. Do not exceed 1/16-inch 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. Place pavers before initial set of cement occurs. Immediately before placing pavers on setting bed, apply uniform 1/16-inch-thick, slurry bond coat to bed or to back of each paver with a flat trowel.
- F. Tamp 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.
- G. Spaced Joint Widths: Provide 1/8-inch nominal joint width with variations not exceeding plus or minus 1/16 inch.
- H. Do not allow traffic on installed pavers until sand has been swept into joints.
- I. After mortar has fully cured for at least 24 hours, spread dry sand and fill joints. Sweep 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.
- J. Do not allow traffic on installed pavers until sand has been swept into joints.
- K. Repeat joint-filling process 30 days later.

### 3.5 REPAIRING

- 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.

END OF SECTION 321400

## SECTION 323113 - CHAIN LINK 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. This Section includes the following:

- 1. Chain-Link Fences: Industrial.
- 2. Gates: Swing.

#### 1.3 SUBMITTALS

- A. Product Data: Material descriptions, construction details, dimensions of individual components and profiles, and finishes for the following:

- 1. Fence and gate posts, rails, and fittings.
- 2. Chain-link fabric, reinforcements, and attachments.
- 3. Gates and hardware.

- B. Shop Drawings: Show locations of fence, each gate, posts, rails, and tension wires and details of extended posts, extension arms, gate swing, or other operation, hardware, and accessories. Indicate materials, dimensions, sizes, weights, and finishes of components. Include plans, elevations, sections, gate swing and other required installation and operational clearances, and details of post anchorage and attachment and bracing.

- C. Samples for Initial Selection: For privacy screen color selection.

- D. Product Certificates: Signed by manufacturers of chain-link fences and gates certifying that products furnished comply with requirements.

- E. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

#### 1.4 QUALITY ASSURANCE

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

- B. Source Limitations for Chain-Link Fences and Gates: Obtain each color, grade, finish, type, and variety of component for chain-link fences and gates from one source with resources to provide chain-link fences and gates of consistent quality in appearance and physical properties.

#### 1.5 PROJECT CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

## PART 2 - PRODUCTS

### 2.1 CHAIN-LINK FENCE FABRIC FOR PERIMETER FENCE

- A. Steel Chain-Link Fence Fabric: Fabricated in one-piece widths for fencing 8 feet in height to comply with Chain Link Fence Manufacturers Institute (CLFMI) "Product Manual" and with requirements indicated below:
  - 1. Height: As indicated.
  - 2. Mesh and Wire Size: 2-inch mesh, 0.120-inch diameter (11 gage).
  - 3. Zinc-Coated Fabric: ASTM A392, with zinc coating applied to steel wire before weaving according to ASTM A817, Type II, zinc coated (galvanized) with the following minimum coating weight:
    - a. Class 1: Not less than 1.2 oz/sq ft of uncoated wire surface.
- B. Selvage: Knuckled at both selvages.

### 2.2 INDUSTRIAL FENCE FRAMING

- A. Round Steel Pipe: Standard weight, Schedule 40, galvanized steel pipe complying with ASTM F 1083. Comply with ASTM F 1043, Material Design Group IA, external and internal coating Type A, consisting of not less than 1.8-oz./sq. ft. zinc; and the following strength and stiffness requirements:
  - 1. Line, End, Corner, and Pull Posts and Top Rail: Per requirements for Light Industrial Fence.
- B. Roll-Formed Steel Shapes: C-sections or other shape, produced from structural steel. Comply with ASTM E 1043, Material Design Group II, with minimum yield strength of 45,000 psi; and the following coating and strength and stiffness requirements:
  - 1. Coatings: Type A, consisting of a minimum of 2.0 oz./sq. ft. average zinc coating per ASTM A123/A 123M or 4.0 oz./sq. ft. zinc coating per ASTM A 653/A653M.
  - 2. Line, End, Corner, and Pull Posts and Top Rail: Per requirements for Light Industrial Fence.
- C. Top Rails: Fabricate top rail from lengths 21 feet or longer, with swedged-end or fabricated for expansion-type coupling, forming a continuous rail along top of chain-link fabric.

### 2.3 TENSION WIRE

- A. General: Provide horizontal tension wire at the following locations:
  - 1. Location: Extended along bottom of fence fabric.
- B. Metallic-Coated Steel Wire: 0.177-inch- diameter, marcelled tension wire complying with ASTM A 824 and the following:
  - 1. Coating: Type II, zinc coated (galvanized) by the hot-dip process, with Class 2 coating weighing not less than 1.2 oz./sq. ft.

## 2.4 INDUSTRIAL SWING GATES

- A. General: Comply with ASTM F 900.
- B. Metal Pipe and Tubing: Galvanized steel. Comply with ASTM F 1083 and ASTM F 1043 for materials and protective coatings.
- C. Frames and Bracing: Fabricate members from round tubing with outside dimension and weight according to ASTM F 900 for the following gate fabric height:
  - 1. Gate Fabric Height: As indicated.
- D. Frame Corner Construction: Welded.
- E. Gate Posts: Fabricate members from round galvanized steel pipe with outside dimension and weight according to ASTM F 900 for gate fabric heights and leaf widths as shown on drawings.
- F. Hardware: Latches permitting operation from both sides of gate, hinges, gate stops and, for each gate leaf, keepers. Fabricate latches with integral eye openings for padlocking; padlock accessible from both sides of gate.
  - 1. Owner furnished padlocks.

## 2.5 FITTINGS

- A. General: Provide fittings for a complete fence installation, including special fittings for corners. Comply with ASTM F 626.
- B. Post and Line Caps: Hot-dip galvanized pressed steel or hot-dip galvanized cast iron. Provide weathertight closure cap for each post.
- C. Rail and Brace Ends: Hot-dip galvanized pressed steel or hot-dip galvanized cast iron. Provide rail ends or other means for attaching rails securely to each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
  - 1. Top Rail Sleeves: Hot-dip galvanized pressed steel or round steel tubing. Not less than 6 inches long.
- E. Tension and Brace Bands: Hot-dip galvanized pressed steel.
- F. Tie Wires, Clips, and Fasteners: Provide the following types according to ASTM F 626:
  - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, complying with the following:
    - a. Hot-Dip Galvanized Steel: 0.106-inch- diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.
  - 2. Round Wire Hog Rings: Hot-dip galvanized steel or aluminum for attaching chain-link fabric to horizontal tension wires.

## 2.6 PRIVACY SCREEN

- A. Privacy Screen: UV-light-stabilized and heat-treated knitted polyethylene (HDPE) screen material thick, sized to fit fence.
  - 1. Visibility Blockage: 88%.
  - 2. Edge Reinforcement: 2" Polypropylene webbing.
  - 3. Grommets: Brass grommets 24 inches o.c.
- B. Color: As selected by Architect from manufacturer's full range.

## 2.7 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer for exterior applications.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

### 3.3 INSTALLATION, GENERAL

- A. General: Install chain-link fencing to comply with ASTM F 567 and more stringent requirements specified.
- B. Post Excavation: Drill or hand-excavate holes for posts in firm, undisturbed or compacted soil.
- C. Post Setting: Hand-excavate holes for post foundations in firm, undisturbed or compacted soil. Set terminal, line and gate posts in concrete footing. Protect portion of posts aboveground from concrete splatter. Place concrete around posts and vibrate or tamp for consolidation. Using mechanical devices to



set line posts per ASTM F 567 is permitted. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during placement and finishing operations until concrete is sufficiently cured.

1. Concrete Footings: Unless otherwise indicated, trowel to a crown to shed water.

### 3.4 CHAIN-LINK FENCE INSTALLATION

- A. Terminal Posts: Locate terminal end, corner, and gate posts per ASTM F 567.
- B. Line Posts: Space line posts uniformly at 8 - 10 feet on center, or as otherwise indicated on Drawings.
- C. Post Bracing Assemblies: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Install braces at end and gate posts and at both sides of corner and pull posts. Locate horizontal braces at midheight of fabric on fences with top rail and at two-thirds fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- D. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch- diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric.
  1. Bottom Tension Wire: Install tension wire within 6 inches of bottom of fabric and tie to each post with not less than same gage and type of wire.
- E. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fencing. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended by fencing manufacturer.
- F. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 2 inches between finish grade or surface and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- G. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts with tension bands spaced not more than 15 inches on center.
- H. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric per ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
  1. Maximum Spacing: Tie fabric to line posts 12 inches on center. and to braces 24 inches on center.
- I. Fencing: Construct fence according to ASTM F 696.
- J. Privacy Screen: Install screen in location indicated, securely attached in place.

### 3.5 GATE INSTALLATION

- A. General: Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. 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.

3.6 ADJUSTING

- A. Gate: Adjust gate to operate smoothly, easily, and quietly, free from 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.

END OF SECTION 323113

## SECTION 323223 - SEGMENTAL RETAINING WALLS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes single-depth and multiple-depth segmental retaining walls with and without soil reinforcement. The Keystone Retaining Wall details provided in the Civil Plans (Sheet C-9.2) are to be utilized as the basis of design for the segmental retaining walls to be installed in detention ponds 1 and 2. Other manufacturers such as Belgard and Versa-Lok can be utilized, so long as the selected product is an approved equal.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide segmental retaining walls capable of withstanding the effects of gravity loads due to soil pressures resulting from grades indicated, and determined according to NCMA's "Design Manual for Segmental Retaining Walls."
  - 1. Include the effects of sloped backfill as indicated on Drawings.
  - 2. Include the effects of superimposed loads (surcharge) as indicated on Drawings.
- B. Drainage: Provide segmental retaining wall drainage system capable of preventing accumulation of groundwater in retained soils and in retaining wall foundation soils.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For installed systems indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle concrete units and accessories to prevent deterioration or damage due to moisture, temperature changes, contaminants, breaking, chipping, or other causes.
- B. Store geosynthetics in manufacturer's original packaging with labels intact. Store on elevated platforms, protected from moisture, sunlight, chemicals, flames, temperatures above 160 deg F or below 32 deg F, and other conditions that might damage them. Verify identification of geosynthetics before using and examine them for defects as material is placed.

### PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Segmental Retaining Wall Units:
    - a. Licensees of Keystone Retaining Wall Systems, Inc.
    - b. Belgard
    - c. Versa-Lok
  - 2. Soil Reinforcement:
    - a. Civil Engineering Fabrics; a division of BP Amoco Chemicals.
    - b. Colbond Geosynthetics.
    - c. HUESKER, Inc.
    - d. Luckenhaus, Inc.
    - e. Strata Systems, Inc.
    - f. TC Mirafi.
    - g. TENAX Corporation.
    - h. Tensar Earth Technologies, Inc.
    - i. Versa-Lok Retaining Wall Systems; a division of Kiltie Corp.

## 2.2 SEGMENTAL RETAINING WALL UNITS

- A. Concrete Units: ASTM C 1372, Normal Weight, except that units shall not differ in height more than plus or minus 1/16 inch from specified dimension.
  - 1. Provide units that comply with requirements for freeze-thaw durability.
  - 2. Provide units that interlock with courses above and below by means of pins and hollow cores filled with drainage fill.
- B. Colors: As selected by Architect from manufacturer's full range.
- C. Shapes: Provide units of basic shape and dimensions indicated with machine-split textured exposed faces.
- D. Cap Units: Provide cap units of same shape as other units with smooth, as-cast top surfaces without holes or lugs.
- E. Special Units: Provide corner units, end units, and other shapes as needed to produce segmental retaining walls of dimensions and profiles indicated and to provide texture on exposed surfaces matching face.

## 2.3 INSTALLATION MATERIALS

- A. Pins: Product supplied by segmental retaining wall unit manufacturer for use with units provided, made from nondegrading polymer reinforced with glass fibers.
- B. Cap Adhesive: Product supplied or recommended by segmental retaining wall unit manufacturer for adhering cap units to units below.
- C. Leveling Base: Comply with requirements in Division 2 Section "Subdrainage" for drainage fill.
- D. Drainage Fill: Comply with requirements in Division 2 Section "Subdrainage."
- E. Reinforced Soil Fill: ASTM D 2487; GW, GP, SW, SP, and SM soil classification groups or a combination of these groups; free of debris, waste, frozen materials, vegetation, and other deleterious matter; meeting the following gradation according to ASTM C 136: 20 to 100 percent passing No. 4

sieve, 0 to 60 percent passing No. 40 sieve, 0 to 35 percent passing No. 200 sieve; and with fine fraction having a plasticity index of less than 20.

- F. Nonreinforced Soil Fill: Comply with requirements in Division 2 Section "Earthwork" for satisfactory soils.
- G. Filter Fabric: Comply with requirements in Division 2 Section "Subdrainage."
- H. Drainage Pipe: Comply with requirements in Division 2 Section "Subdrainage."
- I. Soil Reinforcement: Product specifically manufactured for use as soil reinforcement and as follows:
  - 1. Product Type: Molded geogrid made from high-density polyethylene.
  - 2. Physical Properties: As required for completed segmental retaining walls to comply with performance requirements.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for excavation tolerances, condition of subgrades, and other conditions affecting performance of segmental retaining walls.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 RETAINING WALL INSTALLATION

- A. General: Place units according to NCMA's "Segmental Retaining Wall Installation Guide" and segmental retaining wall unit manufacturer's written instructions. Lay units in running bond.
  - 1. Form corners and ends by using special units.
- B. Leveling Base: Place and compact base material to thickness indicated and with not less than 90 percent maximum dry unit weight according to ASTM D 1557.
- C. First Course: Place first course of segmental retaining wall units on leveling base for full length of wall. Place units in firm contact with each other, properly aligned and level.
  - 1. Tamp units into leveling base as necessary to bring tops of units into a level plane.
  - 2. Place and compact fill, either drainage or soil fill as indicated, to top of first course. Place fill on both sides of wall at same time without disturbing alignment of units. Fill voids between and within units with drainage fill.
- D. Subsequent Courses: Remove excess fill and debris from tops of units in course below. Place units in firm contact, properly aligned, and directly on course below.
  - 1. Install pins and align units according to manufacturer's written instructions.
  - 2. Place fill on both sides of wall at same time, where both sides are indicated to be filled.
  - 3. Fill voids between and within units with drainage fill.
- E. Cap Units: Place cap units and secure with cap adhesive according to manufacturer's written instructions.

#### 3.3 FILL PLACEMENT

- A. General: Comply with requirements in Division 2 Section "Earthwork," NCMA's "Segmental Retaining Wall Installation Guide," and segmental retaining wall unit manufacturer's written instructions.
- B. Place, spread, and compact fill in uniform lifts for full width and length of embankment as wall is laid. Begin at back of wall and place and spread fill toward embankment.
  - 1. Use only hand-operated compaction equipment within 48 inches of wall, or one-half of height above bottom of wall, whichever is greater.
  - 2. Compact drainage fill to not less than 90 percent maximum dry unit weight according to ASTM D 1557.
  - 3. Compact reinforced soil fill to not less than 90 percent maximum dry unit weight according to ASTM D 1557.
    - a. In areas where only hand-operated compaction equipment is allowed, compact to not less than 85 percent maximum dry unit weight according to ASTM D 1557.
  - 4. Compact nonreinforced soil fill to comply with Division 2 Section "Earthwork."
- C. Place a layer of drainage fill at least 12 inches deep behind wall to within 12 inches of finished grade.
  - 1. Place drainage pipe in drainage fill as indicated, sloped 1:50 to drain.
  - 2. Place impervious fill over top edge of drainage fill layer.
- D. Place soil reinforcement in horizontal joints of retaining wall where indicated and according to soil reinforcement manufacturer's written instructions. Embed reinforcement a minimum of 8 inches into retaining wall and stretch tight over compacted backfill. Anchor soil reinforcement before placing fill on it.
  - 1. Place additional soil reinforcement at corners and curved walls to provide continuous reinforcement and to comply with manufacturer's written instructions.
  - 2. Place geosynthetics with seams, if any, oriented perpendicular to segmental retaining walls.
  - 3. Do not dump fill material directly from trucks onto geosynthetics.
  - 4. Place at least 6 inches of fill over reinforcement before compacting with tracked vehicles or 4 inches before compacting with rubber-tired vehicles.
  - 5. Do not turn vehicles on fill until first layer of fill is compacted and second layer is placed over each soil-reinforcement layer.

### 3.4 CONSTRUCTION TOLERANCES

- A. Variation from Level: For bed-joint lines along walls, do not exceed 1-1/4 inches in 10 feet, 3 inches maximum.
- B. Variation from Indicated Batter: For slope of wall face, do not vary from indicated slope by more than 1-1/4 inches in 10 feet.
- C. Variation from Indicated Wall Line: For walls indicated as straight, do not vary from straight line by more than 1-1/4 inches in 10 feet.

### 3.5 FIELD QUALITY CONTROL

- A. Comply with requirements in Division 2 Section "Earthwork" for in-place compaction testing.
  - 1. In each compacted backfill layer, perform at least 1 field in-place compaction test for each 150 feet or less of segmental retaining wall length.

### 3.6 ADJUSTING AND CLEANING

- A. Remove and replace segmental retaining wall construction of the following description:
  - 1. Broken, chipped, stained, or otherwise damaged units. Units may be repaired if methods and results are approved by Architect.
  - 2. Segmental retaining walls that do not match approved Samples and mockups.
  - 3. Segmental retaining walls that do not comply with other requirements indicated.
  
- B. Replace units so segmental retaining wall matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.

END OF SECTION 323223