

02400 - CONCRETE PAVEMENT, CURB & GUTTER, DRIVES, SIDEWALKS

(Last Revised 3/09/15)

SELECTED LINKS TO SECTIONS WITHIN THIS SPECIFICATION

PART 1- General	Concrete Washouts	Herbicides for Bikeways
PART 2 – Products	Coordination of Pours	Joint Sealer
PART 3 - Execution	Curb and Gutter	Liquid Curing Agent
Admixtures	Curb Ramps (ADA)	Reinforcing Steel
C&G Control Joints	Curing	Retaining Walls
C&G Expansion Joints	Curing Materials	Testing
Concrete	Defective Work	Weep Hole Pipe
Concrete Class	Finishing	Welded Wire Fabric
Concrete Placement	Flumes & Ditches	S/W & D/W Construction
Concrete Protection	Forms -Fixed	S/W & D/W Control Joints
Concrete Sidewalk Construction	Forms-Machine Formed	S/W & D/W Expansion Joints

PART 1 - GENERAL

1.1 GENERAL

- A. The contractor shall furnish all labor, materials, tools, equipment, and perform all work and services necessary for or incidental to the construction of concrete pavement, curbing, sidewalks, and steps and other incidental structure as shown on drawings and as specified, in accordance with provisions of the contract documents, and completely coordinated with work of all other trades.
- B. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including general and supplementary conditions apply to this specification.
- B. Section 00825 – Product Substitutions
- C. Section 02200 – Earthwork
- D. Section 02210 – Trenching, Backfilling, And Compaction Of Utilities
- E. Town of Wake Forest Pre-Approved Material/Product List

1.3 SUMMARY

This section includes concrete curbs, combination curb and gutters, ramps, sidewalks, driveways, flumes, valley gutters, median strips, islands, retaining walls, steps, and headwalls on municipal roadways and its appurtenances.

1.4 DEFINITIONS

A. General:

For the purposes of this specification, the following definitions refer to the streets and roadway system that comes under the authority of the Town of Wake Forest, North Carolina as specified within this section and other sections of this manual.

- 1) **Aggregate Base Course:** A layer of graded aggregate materials of a specified thickness placed between the subgrade and the concrete structure or appurtenance.
- 2) **Public Road System:** Roadway, streets, and their appurtenances required for the conveyance of the motoring public that are maintained by either the Town of Wake Forest or the North Carolina Department of Transportation.
- 3) **Subgrade:** The bottom surface of a sidewalk, curb and gutter or driveway shaped to conform to the typical section on which the concrete structure or appurtenance is constructed.
- 4) **Suitable Subgrade:** A subgrade that consists of a material type and density that is approved by the Town's Engineer for placement of a subsequent concrete structure or appurtenance.

B. The following are industry abbreviations for various materials and items:

- 1) **C&G:** Concrete Curb and Gutter
- 2) **D/W** Driveway
- 3) **S/W** Sidewalk
- 4) **WWF:** Welded Wire Fabric

1.5 SUBMITTALS

A. Submit product data, reports, and/or shop drawings, as applicable, for the following:

- 1) Air Entrainment
- 2) Concrete cylinder break tests
- 3) Concrete admixtures
- 4) Joint Sealants and expansion joint material
- 5) Curing compounds
- 6) Job mix formula
- 7) Other embedded items

1.6 QUALITY ASSURANCE

- A. **Geotechnical Testing Agency Qualifications:** An independent testing agency qualified according to ASTM E329 to conduct soil materials and rock-definition testing as documented according to ASTM D3740 and ASTM E548.
- B. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.

- C. The Contractor shall comply with North Carolina Department of Environment and Natural Resources, "Erosion and Sedimentation Control Handbook," latest revision.
- D. Major requirements for concrete pavement, curb and gutter and sidewalk are set out hereinafter and on the drawings (See also the standard details in the Manual). Details not so set out or referenced shall conform to the following standards, which, along with their included references, are declared to be a part of this specification.
- E. For convenience, reference is made in succeeding paragraphs to specific portions of various standards. Also, modifications and additions are made. Neither the reference nor the modifications are intended to de-emphasize any other portion of the standards.
- F. It is the intent of this specification that whenever a procedure or technique is not called out herein, that the industry standard, as represented by ACI, ASTM or other appropriate recommendation, shall be used.
- G. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Concrete Institute (ACI)

ACI 305	Recommended Practice for Hot Weather Concreting
ACI 306	Recommended Practice for Cold Weather Concreting
ACI 316	Specifications for Concrete Pavement and Concrete Bases
ACI 325	Recommended Practice for the Design of Concrete Pavements

American Society for Testing and Materials (ASTM).

ASTM A82	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A185	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A497	Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C33	Standard Specification for Concrete Aggregates
ASTM C94	Standard Specification for Ready-Mixed Concrete
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C150	Standard Specification for Portland Cement
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
ASTM C494	Standard Specification for Chemical Admixtures for Concrete
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM C1116	Standard Specification for Fiber-Reinforced Concrete and Shotcrete
ASTM C1315	Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete
ASTM D422	Standard Test Method for Particle-Size Analysis of Soils (for classification purposes only)
ASTM D448	Standard Classification for Sizes of Aggregate for Road and Bridge Construction
ASTM D994	Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D3740	Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM D4397	Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D5893	Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

ASTM D6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavement
ASTM E329	Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E548	Standard Guide for General Criteria Used for Evaluating Laboratory Competence
ASTM E1745	Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs

American Association of State Highway & Transportation Officials (AASHTO)

AASHTO M144	Standard Specification for Calcium Chloride.
AASHTO M145	The Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
AASHTO M153	Standard Specification for Preformed Sponge Rubber and (ASTM D1752) Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO M171	Standard Specification for Sheet Materials for Curing Concrete
AASHTO M213 (ASTM D1751)	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
AASHTO M224	Protective Coatings for Portland Cement Concrete
AASHTO T99	The Moisture-Density Relations of Soils using a 5.5-pound Rammer and a 12-inch drop
AASHTO T180	The Moisture Density Relations of Soils using a 10-pound Rammer and an 18-inch drop.
AASHTO T191	Density of Soil In-Place by the Sand-Cone Method
AASHTO T204	Density of Soil In-Place by the Drive Cylinder Method
AASHTO T205	Density of Soil In-Place by the Rubber-Balloon Method
AASHTO M284	Standard Specification for Epoxy-Coated Reinforcing Bars: Materials and Coating Requirements

1.7 STANDARD ABBREVIATIONS

ACI	American Concrete Institute
ADA/ABA	Americans with Disabilities Act and Architectural Barriers Act

ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
AASHTO	American Association of State Highway Transportation Officials.
ASTM	American Society for Testing and Materials
CRSI	Concrete Reinforcing Steel Institute
FS	Federal Specifications
MSDS	Material Safety Data Sheets
NCDOT	North Carolina Department of Transportation

Note: Designations such as ASTM, AASHTO, NCDOT, etc. referenced throughout this specification imply the latest revision.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Concrete Handling/Transportation

- 1) Cement concrete plant operations shall comply with the applicable sections of NCDOT *Standard Specifications for Roads and Structures*, Section 1000, *Portland Cement Concrete Production and Delivery*.
- 2) Time limitations and intervals between deliveries shall be in accordance with Section 1000-4E, *Elapsed Time for Placing Concrete* of the NCDOT *Standard Specifications for Roads and Structures*.
- 3) See Part 3 - EXECUTION of these specifications for handling of materials during placement of hydraulic cement concrete.

B. Steel Handling/Examination:

- 1) **Steel Reinforcing Inspection:**
 - a. **Plain Steel Reinforcing:** Inspect materials thoroughly upon arrival. Examine materials for damage or excessive rust. Remove damaged or rejected materials from site. A light coat of rust is permitted to develop on steel bars and fabric; however, rust scaling and flaking is not permitted
 - b. **Coated Steel Reinforcing:** Handling and storage of coated bars shall conform to the requirements of AASHTO M284. Visible damage to the coating shall be patched or repaired with materials compatible to the existing coating in accordance with AASHTO M284.
- 2) **Pre-Installation Inspection:** Prior to being installed, inspect each bar of steel reinforcing for the presence of dirt, paint, oil, rust scaling, flaking or other foreign matter. Remove such matter with appropriate methods and to the satisfaction of the Town's Engineer.

- C. Observe manufacturer's directions for delivery and storage of materials and accessories.
- D. Reinforcing steel shall be stored on platforms, skids, or other supports that will keep the steel above ground, well drained, and protected against deformation. Upon delivery to site, epoxy coated steel shall be covered with an opaque covering. Coverings shall be placed to provide air circulation and prevent condensation.

1.9 PROJECT CONDITIONS

A. PROTECTION OF STREAMS

Do not discharge excess concrete into a drainage pipe, catch basin, ditch, stream, river, pond, or lake.

B. PROTECTION OF ROADWAYS

Do not discharge or allow concrete to spill onto any roadway or appurtenances either during placement or while in transit. Remove spills immediately or otherwise repair street as directed by the Town's Engineer.

C. PROTECTION FROM MARKING:

Newly poured concrete roads, streets, curbs, or sidewalks shall be protected AND guarded from graffiti from passersby until the concrete has sufficiently cured. Failure to prevent graffiti, or other such vandalism, shall result in the new concrete having to be removed and replaced. This requirement shall mandate the Contractor to take the necessary steps in preventing such incidents including, but not limited, to guarding the project after normal working hours.

D. WASHOUT HANDLING

A concrete washout shall be identified on approved construction plans. The area shall be maintained and restored prior to acceptance of the project.

1.10 COORDINATION

Coordinate placement of sidewalk and driveway connections to municipal streets and roadways with the Town's Engineer.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS

2.1.1 PORTLAND CEMENT CONCRETE

A. CONCRETE

Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete*. Cement concrete shall meet the requirements of Section 1000, *Portland Cement Concrete Production and Delivery* and Section 1024, *Materials for Portland Cement Concrete* of the NCDOT Standard Specifications for Roads and

Structures. Concrete strength shall be as specified on Standard Details and drawings. Unless otherwise specified, all concrete shall be Class A (3000 psi), minimum.

All exposed concrete shall be air entrained with an air content conforming to the requirements of Section 1000-4B, *Air Entrainment* of the NCDOT *Standard Specifications for Roads and Structures*. Air entrained admixtures for use in Portland cement concrete shall meet the requirements of AASHTO designation M-154, *Air-Entraining Admixtures for Concrete*. Only those admixtures shall be used which have been approved by the Town's Engineer.

If approved by the Town's Engineer, calcium chloride may be used as an admixture subject to the requirements of Section 1000-4H, *Use of Calcium Chloride* of the NCDOT *Standard Specifications for Roads and Structures*. Calcium chloride shall conform to AASHTO M144, Calcium Chloride, type 2. Do not use calcium chloride in reinforced concrete construction.

Concrete admixtures, when specified, shall conform to Section 1024-3, *Admixtures* of NCDOT *Standard Specifications for Roads and Structures*.

B. CONCRETE CLASS

- 1) Concrete Classes (NCDOT) to Design Compressive Strength at 28 days (f'c):

Class	Minimum Compressive Strength at 28 days (psi)
Class AA	4,500
Class A	3,000
Class B	2,500

- 2) Concrete class for combined curb and gutter, curbs, sidewalks, driveways, flumes, ditches, steps, headwalls, and islands shall be a minimum of Class A or as designated in the specifications or drawings. Machined formed curb shall be Class AA (4500 psi) unless otherwise permitted by the Town's Engineer.

2.1.2 HANDRAILS

Handrails shall conform to the applicable sections and requirements of Section 460, *Bridge Railing* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision. Handrails for trail projects shall comply with the applicable subsections of Section 1074, *Miscellaneous Metals and Hardware* of the NCDOT *Standard Specifications for Roads and Structures*.

2.1.3 JOINT FILLER

A. PREFORMED EXPANSION JOINT FILLER

Utilize preformed joint filler for expansion joint material as applicable for the type use. Material shall be approximately 1/2 inch in thickness and a width and depth equal to those of the incidental structure. However, unless otherwise directed by the Town's Engineer, install expansion joint filler 1/2-inch below the concrete surface and seal for maximum protection from water infiltration, weathering and to assure proper performance. [See paragraph 2.1.4 for concrete joint sealer requirements.](#)

- 1) **Asphalt Expansion Joint:** Typically used in 80% of all control joint applications; *the expansion joint material of choice*. This joint is *to be used in sidewalks, driveways and streets*. Expansion joint is composed of a blend of asphalt, vegetable fibers, and mineral fillers formed under heat and pressure between 2 asphalt-saturated liners. Joint material is waterproof, flexible, non-absorbing, self-sealing, and permanent and shall meet AASHTO M33, ASTM D994, and Federal Specification HH-F-341 F for thicknesses ½” through 1”.
- 2) **Standard non-extruding cork (not for use in areas exposed to the weather):** *Usually used where a constant friction fit is desired*. Cork bonded with phenolic resin, highly resilient, will compress without extrusion and recover to 95% of its original thickness after 50% compression (ASTM D1752, Type II; AASHTO M153, Type II).
- 3) **Self-expanding cork (not for use in areas exposed to the weather):** *Usually used where high resiliency is needed such as in sewage plants, floodwalls, spillways, filtration plants and in commercial and industrial applications*. Compressed under heat and pressure to permit expansion to 140% of original thickness after installation, activated by humidity (ASTM D1752, Type III; AASHTO M153, Type III).
- 4) **Sponge rubber:** *Frequently used on bridge structures and sewage treatment plants that undergo rapid changes in temperature. Used around pillars, drains, hydrants, lamp and signposts as well as in isolation applications or between materials having dissimilar coefficients of expansion*. Gray, non-absorbent, closed-cell, flexible and resilient, density of not less than 30 pcf (ASTM D1752, Type I; AASHTO M153, Type I).
- 5) **Standard Asphalt Saturated Fiber:** *To be used in sidewalks, driveways and streets, commercial and industrial applications. Install ½” below the surface and seal joint with ASTM D3405 polymeric hot-applied sealant for maximum protection from water infiltration, weathering and to assure proper performance*. Cellular fibers bonded together and uniformly saturated with asphalt, resilient, flexible and non-extruding, when compressed to half of its original thickness, it will recover to a minimum of 70% of its original thickness, (ASTM D1751; AASHTO M213).

2.1.4 JOINT SEALERS

- A. **Hot Applied Joint Sealant Compound For Concrete Pavements, Bridge, Curb And Gutter Joints, Crack And Joint Sealing Projects (Non-pedestrian areas)** (To be used on all Town or NCDOT projects): Premium quality hot applied joint sealer shall be a rubberized/asphalt product meeting ASTM D6690, *Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements*. Hot applied Joint sealer is not to be used in areas of a heavy pedestrian traffic.
- B. **Concrete Joint Sealant for Pedestrian Traffic Areas:** Use low modulus silicone sealant meeting ASTM D5893, *Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements*.
- C. **Concrete Joint Sealant Pedestrian Traffic And Driveway Joint Sealing Compound:** Two-part component cold applied urethane polymer modified with coal tar sealant,

self-leveling non-tack material meeting ASTM C920 *Standard Specification for Elastomeric Joint Sealant*, Type M, Grade P, Class 25, use T; Federal Spec SS-S-200, Type H, Federal Spec SS-S-195, Type H.

- D. **Other Joint Sealant Materials:** Material shall meet the NCDOT Standard Specifications for Roads and Structure, Section 1028 *Joint Materials* for other acceptable joint sealer materials.

2.1.5 BOND BREAKERS AND BACKER RODS

- A. **Bond Breakers and Backer Rods:** Material shall meet the NCDOT Standard Specifications for Roads and Structure, Section 1028 *Joint Materials* for bond breakers and backer rod material specifications.

2.1.6 CURING MATERIALS

- A. Liquid membrane curing compound, PE film, burlap, or water for curing shall meet the requirements of Section 1026, *Curing Agents* of the NCDOT *Standard Specifications for Roads and Structures*.
- B. **Liquid Curing Compound:** Liquid membrane forming compounds meeting ASTM C309; AASHTO M148, Type 2, white pigmented for Type ID, clear to translucent with fugitive dye.
- C. **Sheeting Material For Curing Concrete:** Use sheeting material meeting AASHTO M171 *Standard Specification for Sheet Materials for Curing Concrete*.

2.1.7 INSULATION BLANKET

In cold weather operations, insulated blankets must retain or supply moisture and maintain the temperature at the outermost surfaces of concrete above 50° F for at least 72 hours and above 32° F for at least an additional 48 hours. For other measures pertaining to placing concrete in cold weather, see Section 420-7, *Placing Concrete in Cold Weather* of the NCDOT *Standard Specifications for Roads and Structures*.

2.1.8 WEEP HOLE PIPE

Material shall be minimum schedule 40 PVC pipe meeting ASTM D1785.

2.1.9 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement*.

2.1.10 REINFORCING STEEL

A. REINFORCING BARS

Steel reinforcing bars shall be minimum grade 60 and shall conform to the requirements of AASHTO M31, *Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcing* and ASTM A615. Reinforcing bars shall also conform to the applicable requirements of Section 1070, *Reinforcing Steel*, of the NCDOT *Standard Specifications for Roads and Structures*.

B. WELDED WIRE FABRIC

Welded wire mesh shall be of the size specified by the Town's Engineer but shall be minimum 6 x 6, W2.9 x W2.9 and shall conform to the requirements of AASHTO M32, *Cold-Drawn Steel Wire for Concrete Reinforcement* and the applicable sections of Section 1070, *Reinforcing Steel* of NCDOT *Standard Specifications for Roads and Structures*.

2.1.11 CONCRETE ADMIXTURES

Concrete admixtures, when specified by the Town's Engineer, shall conform to Section 1024-3, *Admixtures* of NCDOT *Standard Specifications for Roads and Structures*.

PART 3 – EXECUTION

3.1 FORMS

3.1.1 FIXED FORMS

- A. **Forms - Materials and Dimensions:** Provide metal side forms not less than 7/32 - inch thick, depth equal to edge thickness of concrete. Steel forms shall be used for the construction of curb and gutter. Fixed forms shall be straight, free from warp, and of such construction that there will be no interference with the inspection of grade and alignment. Metal templates, not more than 3/16 inch in thickness and manufactured in accordance with the curb and gutter section, shall be set in the places provided in the forms not more than 10 feet apart. Templates shall be adjusted to prevent short sections (less than 5 feet).

Radial forms shall be sufficiently flexible or otherwise designed to provide a smooth, uniform, curved surface of the required radius.

For special shapes that are difficult to form using the metal forms, flexible, curved or wood forms may be used as long as the form leaves a uniform face free from kinks, depressions, bends or protrusions.

- B. **Form Support:** Forms shall extend the entire depth of the item and shall be braced and secured so that no deflection from alignment or grade will occur during concrete placement. Compact subgrade cut grade to support forms and superimposed machine loads. Use bearing stakes driven flush with bottom of form to supplement support as necessary. Do not use earth pedestals.
- C. **Staking Forms:** Joints are to be neat and tight. Stake pin securely with at least 3 pins for each 10-foot section.
- D. **Forming/Preparation:**
- 1) Use clean forms and oil forms prior to placement of concrete.
 - 2) Set forms sufficiently in advance of work to permit proper inspection by the Town and to allow readjustment if required.

- 3) Previously finished pavement or curb and gutter, contiguous with new work, may serve as side form when approved by the Town's Engineer or his representative.

E. **Curb and Gutter – hand formed (Fixed Forms):**

- 1) **Templates/Jointing:** Curb and gutter metal templates, not more than 3/16 inch in thickness and manufactured in accordance with the curb and gutter section, shall be set in the places provided in the forms not more than 10 feet apart with expansion joints not more than 90 feet apart. Templates shall be adjusted to prevent short section (less than 5 feet).
- 2) **Subgrade Fine Grading:** When back and front forms have been set to exact grade and secured, the dividing plates shall be inserted and trued up. With these forms as templates, fine grading to exact sub-grade elevation shall be completed by hand. Face forms shall then be set. The Contractor shall, at all times, have at least one hundred feet (100) of forms set and grade tested and approved by the Engineer, ahead of pouring operations. He shall use every effort to observe any possible misalignments in grades and shall call such to the attention of the Town's Engineer or his representative promptly.
- 3) **Cross Section:** Unless otherwise noted on the plans, curb and gutter shall be of the vertical curb type, conforming to the dimensions shown in the standard details except where a 30 inch valley curb is used. See [Standard Detail 9.02](#).
- 4) **Termination of Curb and Gutter:** All concrete pours shall terminate at a template. If pouring is to be resumed within one hour or less, any excess concrete that exists after the template has been reached may be spread in the bottom 2 inches of the gutter form adjoining the completed curb or either the concrete is to be discarded from the forms.

3.1.2 **CURB AND GUTTER- SLIP (MACHINE) FORMED (PREFERRED OVER HAND FORMED):**

- A. **Equipment:** The slipform equipment shall be self-propelled and shall be equipped to consolidate, form, extrude, and finish the freshly placed concrete in such a manner that a minimum of hand finishing is required to produce a dense, consolidated, homogenous product. Slipform equipment shall be controlled to line and grade by automatic sensing, guidance, and control devices such that the machine automatically senses and follows taut guidelines or other stable reference, performing any necessary corrective action to ensure the correct grade and alignment is achieved.

The Contractor shall plan and stage the work to eliminate the need for the slipform machine to be stopped during placement operations.

- B. **Attachments:** The forms on the equipment must meet the precise dimensions shown on [Standard Detail 9.02](#) for the different types of curb. A sufficient number of vibrators shall be provided on the machine and be in good working order.
- C. **Line and Grade Controls:** It shall be the Contractor's responsibility to set the line and grade controls for his machine. These controls shall be checked by the Town's Contractor before any "trimming" or pouring occurs. However, approval of these controls by the Town's Contractor shall not relieve the Contractor of the

responsibility of obtaining the planned grade or alignment according to the construction stakes.

- D. **Subgrade Trimming:** It shall be the responsibility of the Contractor to ensure that the subgrade conforms to the Standard Details. No extra payment shall be made to the Contractor for "trimming" the subgrade if such "trimming" is less than the 6-inch limit allowed for unclassified excavation as defined in Section 02200, *Earthwork*. Before pouring operations begin, the subgrade shall be checked by the Town's Contractor.
- E. **Concrete Placing Operations:** Before the machine starts a pour, the slump of the concrete will be checked in the presence of the Town's Contractor. This slump must be between 0 and 2 inches. In the event that the slump exceeds 2 inches, the concrete will be rejected.

If it is determined by the Town's Contractor that the poured curb or gutter does not meet the exact dimensions of the "standard drawings" or for some other reason it does not conform to these specifications, (alignment, grade, materials, etc.) then the Contractor, at his own expense, shall remove the faulty work before concrete obtains full set. No compensation shall be made for unsatisfactory work.

The Contractor shall make sure that sufficient vibration of the concrete occurs. If vibrators fail to function, all operations shall cease until they are satisfactorily repaired.

Where storm inlets are designated, the Contractor shall either leave a sufficient blank space to be hand formed later or work concrete to the exact dimensions for the standard inlet specified.

- F. **Scoring/Expansion Jointing:** Provide scoring at 15-ft intervals. Expansion joints are to be provided at a minimum of 90-ft intervals.
- G. **Defective Curb & Gutter:** Honeycombed concrete shall be filled with a sand/cement paste and allowed to cure prior to backfilling curb. If in the opinion of the Town's Engineer the honeycombing, blemish or damage by construction equipment is extensive to the point of rendering a weak, cracked or otherwise questionable section of curb, in strength or appearance, the Town's Engineer will require the curb section to be replaced at the Contractor's expense. See also [paragraph 3.4.13](#), below.
- H. **Excessive grout:** The use of excessive grout along the curb and gutter section will not be tolerated. The use of "mules" shall be limited to obtaining the desired finish - they should not be allowed to alter the section of the curb or unnecessarily work moisture to the surface. No floating and little to no troweling should be necessary against the curb face in order to obtain a true and proper section. The section should be obtained with the curb face form board.

3.1.3 JOINING CATCH BASINS

- A. **Curb Opening Inlet – Curb Construction:** At all curb opening inlet type catch basins, there will be a short section of gutter in front of the curb opening inlet – the curb being replaced by the casting. The catch basin casting shall be parallel to and on the grade with the back form of the curb and gutter with the casting face extending 6 inches toward the pavement. The gutter area shall be so shaped and sloped as to

increase in slope toward the curbing to an extent that when opposite the catch basin casting, it will provide a 6 inches clear opening below the inside of the casting top. This warped section at, and adjacent to, each catch basin shall have the exact same finish texture as that of the other curbing present and shall be poured at the same time, where possible. A double ply of 30-pound building felt shall be inserted on all sides of casting covers that come in contact with any concrete.

3.2 CURB & GUTTER JOINTS

3.2.1 CURB & GUTTER - CONSTRUCTION/CONTRACTION JOINTS

- A. **General:** Provide joints of various types as called for on drawings or required here in these specifications. Hold location and alignment to within plus or minus 1/4 inch. Finish concrete surface adjacent to a previously placed slab to within plus or minus 1/8 inch, with tooled radius of 1/4 inch.
- B. **Construction (Cold) Joints, Control Joints/Contraction Joints** (transverse jointing):
- 1) Provide transverse control/contraction joints for crack control for fixed forms at the following locations:
 - a. Locate joints as shown on the plans or standard details, except as provided herein.
 - b. At approximately 15 foot intervals.
 - c. Space joints no closer than 5 feet.
 - d. At the gutter where the curb and gutter ties to the gutter apron of drop inlets;
 - e. Locate joints to line up with joints in concrete pavement when placed adjacent to concrete pavement.
 - f. When time elapsing between consecutive concrete placements exceeds 45 minutes, and
 - 2) Transverse joints for crack control may be formed by using one of the following methods:
 - a. Removable templates.
 - b. **Tooled or Formed Groove Joints (hand formed or machine formed C&G):** Form groove in freshly placed concrete with tooling device specifically constructed for this purpose. Groove dimensions shall be 3/8 inch at surface and 1/4 inch at root. Score depth for non-template formed joints shall be a minimum of 1 1/2 inches deep (1/4 of concrete depth). If formed by a tool is used, make a radius of 1/8" at the corner of the adjacent concrete.
 - c. **Sawed Joints:** Saw 1/4-inch groove in green concrete. Commence sawing as soon as concrete is hard enough to withstand sawing operation without chipping, spalling, tearing, or dislodging aggregate regardless of the time of day or weather but not more than 24 hours after the concrete has been placed.

Thoroughly wet surface to protect membrane cure and re-coat afterward. Complete saw cutting before shrinkage stresses cause cracking.

- d. Leave-In Type Joints: In lieu of sawed or tooled joints, approved “leave-in” type insert may be employed. Leave-in type joints to be placed in concrete prior to pour.
 - e. Joints may be formed or created using other approved methods approved by the Town’s Engineer that will successfully induce and control the location and shape of the transverse cracks.
- 3) **Template Removal:** If templates are used for transverse joints, templates shall be removed by stages, but not entirely until the concrete has become thoroughly hard. After removal of the templates, there must be a clear division throughout between these sections. Edging tools will be used to form an edge along the back and front form and at each template.
- 4) **Control Joints/Contraction Joints Joint Sealing:**
- a. Thoroughly clean the joint to remove all foreign matter. Dry joints before sealing. Entirely fill joint to within 1/8- to 1/4-inch of the surface of the concrete with joint sealer. Immediately remove any sealer spilled on the surface of the concrete.
 - b. Fill joints in gutter with joint sealer to top surface of gutter.
 - c. Seal all joints except for joints in curb sections not having an integral gutter. This includes tooled or sawed joints.
 - d. Place joint sealant in cracks after removal of templates.
 - e. Joints are to be sealed before backfilling or performing adjacent operations.
 - a. See [paragraph 2.1.4, Joint Sealers](#) for material spec.

3.2.2 CURB & GUTTER - EXPANSION JOINTS:

- A. On non-reinforced or non-load transferring expansion joints, insert and attach expansion joint material to either the form or the existing concrete.
- B. Cut the filler into the same shape and size as the area to be covered except cut it 1/2-inch below any surface that is exposed to view in the finished work. As an option, cut the cut the filler the same size and shape as that of the adjoining surfaces and cut back the material 1/2-inch on the surface that are exposed to view after the concrete hardens. Cut the filler out of as few pieces as practicable and, except as noted above, completely fill the space provided. Fasten the pieces in any one joint together in an approved manner. Do not use loose fitting or open joints between section of filler or between filler and forms. Place 2-ply roofing felt over all joints in the filler material in vertical expansion joints below top of curbs. Place the felt on the side of the joint adjacent to the new pour.

Use an optional second layer to obtain the required thickness, when a thickness of more than 1-inch is required.

- C. Select type of preformed expansion joint filler to match use. See Section 2 – PRODUCTS of these specifications for approved expansion materials.
- D. At load-transferring expansion joints, stake joint material in place as well as space and support load transfer devices (which usually consist of dowels) as called for on the plans.
- E. Provide expansion joints at the following locations/intervals:
 - 1) Expansion joints shall be formed at intervals of approximately 90 feet on centers,
 - 2) At all radii PC or PT points at concrete entrances and curb returns,
 - 3) At locations no less than 3 feet and no more than 10 feet from drop inlets,
- F. **Expansion Joint Sealing:**
 - 1) Thoroughly clean the joint to remove all foreign matter. Dry joints before sealing.
 - 2) Entirely fill joint to within 1/8- to 1/4-inch of the surface of the concrete with joint sealer. Immediately remove any sealer spilled on the surface of the concrete.
 - 3) Joints are to be sealed before backfilling or performing adjacent operations.
 - 4) See [paragraph 2.1.4, Joint Sealers](#) for material spec.

3.3 CONCRETE SIDEWALK AND DRIVEWAY ENTRANCES - JOINTS

3.3.1 CONTROL/CONSTRUCTION JOINTS:

- A. Control/Construction Joints may be formed by any of the methods specified above for Concrete Curb & Gutter.
- B. Provide control/construction joints for crack control at the following locations:
 - 1) Locate joints as shown on the plans or standard details, except as provided herein.
 - 2) At approximately 5 foot intervals. Typically, the slab between expansion joints shall be divided into equal sections of not more than 5 feet.
 - 3) Where slabs are more than 7 feet in width, the Town's Engineer may require that scored control joints be formed longitudinally to obtain uniform blocks that are approximately square.
 - 4) Transverse control joints shall also be installed where the corners of the drop inlets project into the sidewalk.
 - 5) When time elapsing between consecutive concrete placements exceeds 45 minutes.

- C. Control/Construction joints shall be laid out in such a manner as to be placed radial to curves. Do not run joints such that they create oblique or sharp angles along edges of concrete work.
- D. Control joints shall extend into concrete for at least 1/4 of the depth (e.g 1 inch for 4-inch concrete sidewalk) and shall be approximately 1/8 inch in width.
- E. Keyway Joints: Install permanent joint strips (which are to be left in place). Stake and support like side form. Provide dowels or tie bars, if called for on plans.
- F. Score joints formed by a jointing tool, trowel, or other approved means.

3.3.2 EXPANSION JOINTS:

- A. Provide expansion joints for at the following locations:
 - 1) Sidewalk expansion joints shall be installed every 30 linear feet of sidewalk, where sidewalk abuts existing curbs, pavements, a structure or as directed by the Town's Engineer.
 - 2) Concrete flat work expansion joints shall be placed where concrete abuts against a structure, curb & gutter, manholes, or as otherwise directed by the Town's Engineer. Expansion joints shall also be formed around appurtenances extending into and through the sidewalk.
 - 3) Preformed expansion joints shall also be installed between concrete sidewalk and any adjacent fixed structure which is not tied to the sidewalk with steel dowels.
- B. Slabs shall be separated by transverse preformed joint filler 1/2 inch in thickness that extends from the bottom of the slab to approximately 1/4 inch below the top surface. An expansion joint shall be formed and filled with a minimum 1/2 inch thick preformed joint filler.
- C. See Section 2 – PRODUCTS of these specifications for approved expansion joint material.
- D. Joint Sealant: Seal control/Construction joints and expansion joints as outlined above for Curb and Gutter. See [paragraph 2.1.4, Joint Sealers](#) for material specification for pedestrian traffic use.

3.4 CONSTRUCTION – ALL CONCRETE ITEMS

3.4.1 CONSTRUCTION OF SUBGRADE

- A. **Subgrade Preparation:** Excavation and subgrade preparation shall be in strict compliance with Section 02200, *Earthwork*. The subgrade upon which this work is to be placed shall be shaped and compacted to a firm, even surface conforming to the elevation and cross-sections shown on the plans, the standard drawings, or as directed by the Engineer. All soft, frozen, and unsuitable material shall be removed and replaced with approved material. The subgrade shall be moist when the concrete is placed.
- B. **Bicycle/Greenway Subgrade:**

- 1) Pavement subgrade should be prepared in accordance with paragraph 3.1.1 A, above and shall conform to the grade and cross-section shown on the plans.
 - 2) Herbicides shall conform to Section 1060-13, *Herbicides* of the NCDOT Specifications for Roads and Structures, latest revision shall be applied to the aggregate base course and/or subgrade immediately prior to paving. The rate of application shall be as recommended by the herbicide manufacturer. Herbicides shall not be left uncovered for longer than 15 minutes. Herbicides shall not be used where they may contaminate water used for irrigation or drinking purposes.
- C. **Subgrade Fine Grading (Trimming):** When forms have been set to exact grade and secured, fine grading to exact sub-grade elevation shall be completed by hand. Before pouring operations begin, the Contractor shall have forms set and grade tested and approved by the Contractor ahead of pouring operations. Subgrade fine grading shall be the responsibility of the Contractor to ensure that the subgrade conforms to the Standard Details.

3.4.2 PLACING– ALL CONCRETE ITEMS

The concrete shall be placed in the forms in such a manner as to prevent the segregation of the mortar and the aggregate. The concrete shall be spaded, tamped, or vibrated sufficiently to bring the mortar to the surface. Concrete shall not be dropped a distance of more than 5 feet.

Prior to and during concrete placement, the Contractor's foreman or formsetter shall carefully watch all alignment and grades to detect any errors in grade or misalignment. In the event any of the work is damaged from any cause or prove defective in any way, or is out of alignment or grade, the Contractor shall remove such work and replace at his own expense. The detection of poor subgrade shall also be his responsibility.

When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms in order to eliminate all honeycombing. Mix shall be rodded or vibrated to eliminate voids. Concrete shall be floated to the proper grade and alignment, free from depressions or other irregularities, after which the exposed surfaces shall then be screeded with a straight edge and finished with a steel or wooden trowel. The concrete shall be troweled smooth and, before the concrete obtains full set, very lightly brushed with a brush moistened with clear water. No mortar shall be used in the finishing. Immediately following finishing operations, the finished concrete shall be cured and protected in accordance with these specifications.

3.4.3 CURB AND GUTTER:

- A. **Material, Grade and alignment:** Concrete for curb and gutters, curb returns, gutters and driveway gutters shall be 3000 psi 28 days ([Class A – see paragraph 2.1.1.B](#)), air entrained concrete. The alignment and grade of the curb and gutters will be established by means of offset stakes, and the completed work shall accordingly conform thereto. The Contractor's foreman or formsetter shall carefully watch all alignment and grades to detect any errors in grade or misalignment. In the event any of the curbs and gutters are damaged from any cause or prove defective in any way, or are out of alignment or grade, the Contractor shall remove such sections and replace at his own expense. The detection of poor subgrade for curb and gutter shall be his responsibility.

- B. **Excavation and subgrade preparation:** Prior to placement of curb & gutter, a proof-roll inspection of the subgrade under the proposed curb & gutter shall be witnessed by the Town of Wake Forest or a Geotechnical Engineer. Proof rolling shall be performed by using a fully loaded tandem (25 ton gross vehicle weight) dump truck or tri-axle with the third axle up. Water tankers or other similar equipment will not be allowed. Areas, which do not pass the initial inspection, shall be repaired in accordance with section 02200 and re-inspected.
- C. **Placing and finishing:** When sufficient concrete has been placed in the forms, it shall be well spaded along all areas in contact with the forms in order to eliminate all honeycombing. The concrete shall be floated to the proper alignment and grade, after which it shall be trowelled smooth and very lightly brushed. Face forms shall be removed as soon as concrete has attained sufficient set for the curb to stand without slumping. Templates shall be removed by stages, but not entirely until the concrete has become thoroughly hard. After removal of the templates, there must be a clear division throughout between these sections. Edging tools will be used to form an edge along the back and front form and at each template. The exposed surface shall then be smoothed by the use of a suitable finishing tool.
- D. **Backfilling of Curb and Gutter:** Backfilling of Curb and gutter shall be in strict compliance with the specifications as stated in section 02200, Earthwork.
- E. **Dressing Up:** After the curb and gutter and adjacent paving has been completed, that area between the curb and sidewalk shall be cleared of all construction debris and neatly graded.
- F. **Curb and Gutter Replacement:** The Town will require the removal and replacement of the curb & gutter where it has been broken, cracked, excessively chipped or has become misaligned. Such areas designated by the Town's Engineer shall be repaired at no cost to the Town. Curb and gutter replaced shall conform to that now in place adjacent to the repaired area, as to section and shall conform to the requirements for new work as to strength and construction. When curb & gutter has been replaced, no section less than 5 feet in length shall result.
- G. **Measurement:** Measurement of curb and gutter shall be by actual linear feet of curb and gutter installed measured at the bottom of the face of the curb, including that area across catch basins.

Where driveways occur, the curb and gutter measurement shall continue **across** the driveways, and that area from a line drawn 1-foot behind the face of the curb extended, or the gutter line, shall be paid for as curb and gutter. The remaining concrete in the driveway, between 4 feet back of the face of the curb and that line, shall be paid for as 6-inch concrete at the price bid in the proposal. See [Standard Detail 9.08](#) for a clearer understanding.

- H. **Payment:** The quantity of combination curb and gutter, measured as herein before specified, will be paid for at the contract unit price for the cross-section shown on the drawings. The price paid per linear foot for combination curbs and gutters shall include full compensation for furnishing all labor, materials, tools, and equipment, and doing all work involved in excavation, backfilling, and preparing the sub-grade for these structures and constructing the combination curb and gutter complete, in place, as herein before specified, including furnishing and placing all expansion-joint filler, and joint sealing compound. Valley gutters shall be paid on a linear footage

basis at the same unit price as curb and gutter. No pay item for handicap ramp depressions in curb. Handicap access ramps are to be paid by the square yard of concrete for the prescribed thickness noted either on the plans or in the standard details.

3.4.4 SIDEWALKS, DRIVEWAYS

- A. **Material, Grade and alignment:** Concrete for sidewalks and driveways shall be 3000 psi at 28 days ([Class A – see paragraph 2.1.1.B](#)), air entrained concrete. The alignment and grade of sidewalks will be established as shown on the drawings or otherwise indicated in the standard details. Typically, the alignment and grade of the sidewalks will be determined from the previously placed concrete curb and gutter (see [Standard Detail 9.11](#)) but can vary depending on whether the curb is located either upgrade or downgrade depending on location of driveway aprons (see [Standard Details 9.08](#)). Typical sections can be deviated from only when approved by the Town's Engineer or his representative. Driveways shall connect the openings in the curb and gutter and extend across to the back edge of the sidewalks as shown on the drawings (see [Standard Detail 9.08](#)). In the event any of the sidewalks or driveways are damaged from any cause, or prove defective in any way, or are out of alignment or proper grade, the Contractor shall remove such sections and replace at his own expense.
- B. **Construction of Sidewalks and Driveways:** After the forms have been set, check the sub-grade for proper compaction before allowing any concrete to be placed. Forms and subgrade will be inspected by the Town of Wake Forest prior to placement of concrete. All materials incorporated in this concrete shall conform to the provision as set out herein before and shall be mixed and deposited in accordance with the requirements of these specifications. Sidewalks shall be "scored" at five (5) foot intervals (see [paragraph 3.3, Concrete Sidewalk and Driveway Entrances – Joints](#)). If sidewalk is greater than six feet in width, scoring shall be as directed by the Engineer. All "scores" shall be straight and rounded at the surface with the proper edging tool, or as directed by the Town's Engineer. Outside edges of the sidewalk slab and joints shall be edged with an edging tool having a radius of 1/4 inch.
- The Town will require the removal and replacement of sidewalks and driveways that have been broken, cracked, excessively chipped or misaligned. Such areas designated by the Town's Engineer shall be repaired at no cost to the Town. Sidewalks and driveways replaced shall conform to that now in place adjacent to the repaired area, as to section and shall conform to the requirements for new work as to strength and construction.
- C. **Sidewalk Expansion Joints:** Sidewalk expansion joints shall be installed every 30 linear feet of sidewalk, where sidewalk abuts existing curbs, pavements, driveways, a structure (such as a manhole or junction box) or as directed by the Town's Engineer. See [paragraph 3.3.2, Expansion Joints](#).
- D. **Excavation and Sub-Grade Preparation:** Excavation and sub-grade preparation for concrete sidewalks and driveways shall be in strict compliance with the specifications as stated in section 02200, Earthwork.
- E. **Placing:** Concrete placement shall terminate at a template. If concrete placement is to be resumed within one hour or less, any excess concrete that exists after the template has been reached may be spread in the bottom two (2) inches of the adjoining sidewalk section, or disposed of as directed by the Engineer.

- F. **Measurement:** Unless otherwise shown in the proposal, concrete sidewalks and driveways shall be measured by area in square yards.. The measurement of 4-inch concrete sidewalk shall be by actual field measurement and shall not include that portion of 6-inch concrete where driveways cut across the sidewalk area. This area shall be measured as 6-inch concrete driveway as applicable.
- G. **Payment:** The quantity of 4 inch sidewalk and 6 inch driveways measured as herein before specified will be paid for at the applicable contract unit price. The price per square yard shall include full compensation for furnishing all labor, materials, tools, and equipment and doing all work involved in excavating, backfill, and preparation of the sub-grade for sidewalks and driveways, and construction sidewalks and driveways complete, in place, as herein before specified. Brick walks, driveways, or steps shall be paid for by the square foot.
- 3.4.5 CURB RAMPS (ADA)**
- The ramps shall be constructed as shown on the Town's Standard Detail drawings for the type shown on the plans or as directed by the Town's Engineer to meet ADA/ABA requirements.
- 3.4.6 PORTLAND CEMENT CONCRETE RETAINING WALLS, HEADWALLS, STEPS, PIERS FOR STREAM CROSSINGS, FLUMES AND DITCHES, MEDIAN BARRIERS, MEDIAN STRIPS, ISLANDS, ETC.**
- A. **General Requirements**
- This work shall consist of Portland cement concrete retaining walls, headwalls, steps, piers for stream crossings, flumes and ditches, median barriers, median strips, islands, etc. constructed in accordance with these specifications. These structures shall be constructed to the dimensions, cross-section, and located as shown on the plans, shown on the Standard Details, or as directed by the Town's Engineer.
- B. **Reinforcing Steel**
- Reinforcement steel shall be placed in accordance with the drawings, the Concrete Reinforcing Steel Institute's *Placing Reinforcing Bars Recommended Practices*, the latest edition of ACI 318, *Building Code Requirements for Reinforced Concrete*, latest edition and Section 425, *Fabricating and Placing Reinforcement* of the NCDOT *Standard Specifications for Roads and structures*. See also [paragraph 2.1.10, Reinforcing Steel](#) of this specification.
- C. **Handrails**
- Handrails shall be placed in accordance with Section 1074, *Miscellaneous Metals and Hardware* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.
- D. **Flumes And Ditches**
- Concrete flumes and ditches shall be constructed in accordance with Section 850, *Concrete Paved Ditch* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

E. Median Barriers, Median Strips And Islands

Concrete median barriers, median strips, and islands shall be constructed in accordance with Section 852, *Traffic Islands and Medians* of the NCDOT *Standard Specifications for Roads and Structures*, latest revision.

F. Piers For Stream Crossings, Steps, Headwalls And Retaining Walls

Concrete retaining walls shall be constructed in accordance with Sections 420, *Concrete Structures* of the NCDOT *Standard Specifications for Roads and Structures*.

3.4.7 CONCRETE PLACEMENT COORDINATION

It will be the responsibility of the Contractor to coordinate the times of pours with the Inspector. Sufficient notice shall be given to the Inspector so that he/she can check all aspects of the work before the pouring operations begin. Under no circumstances shall the Contractor pour concrete until the Inspector has had sufficient time to make checks of the work. An inspection shall be requested at least 24 hours prior to any concrete placement.

The maximum interval between the placing of batches at the work site shall not exceed 20 minutes. See also Section 1000-4E, *Elapsed Time for Placing Concrete* and Table 1000-2 of the NCDOT *Standard Specifications for Roads and Structures*.

3.4.8 FINISHING

A. **General:** As soon as concrete is placed, strike off and screed to crown and cross section, slightly above grade so that consolidation and finishing will bring to final drawing elevations. Maintain uniform ridge full width with first pass of first screed.

B. Pavement, Curb and Gutter and Similar Surfaces.

- 1) Consolidate by vibrating screeds, internal units or a combination
- 2) Float by longitudinally reciprocating float, passing gradually from edge to edge. Ensure successive advances do not exceed half the length of the float.
- 3) Test level of slab with minimum 10-foot straightedge. Fill depressions with fresh material, consolidate and refinish. Cut down high areas and retest.
- 4) Belt surface with 2-ply canvas belt, using transverse strokes while advancing along centerline.
- 5) Provide final finish by full width burlap or carpet drag, drawn longitudinally. Keep drag clean to avoid build up and consequent scarring.
- 6) Tool pavement edges with suitable edger.
- 7) Retest with straightedge. If pavement shows deviation of more than 1/8 inch in 10 feet remove and replace.

C. Sidewalk, Steps, Ramps, And Similar Surfaces.

- 1) Consolidate by vibrating screeds, internal units or a combination.
- 2) Test with 6-foot straight edges equipped with long handles and operated from off the sidewalk. Draw excess water and laitance off from surface.
- 3) Float finish so as to leave no disfiguring marks but to produce a uniform granular or sandy texture.
- 4) Tool pavement edges with suitable edger.

3.4.9 CURING

A. Curing – Year Around

Curing shall be accomplished by preventing loss of moisture, rapid temperature change, and mechanical injury from rain or flowing water for a period of 3 days when normal Portland cement has been used or 7 days when pozzolan mix designs are used. Curing shall be started as soon as placing, finishing, and free water has disappeared from the surface of the concrete. One of the following methods of curing are required year round:

- 1) **Liquid membrane compound:** Apply membrane-curing compound for curing, sealing, and moisture retention. The entire exposed surface of the structure shall be sprayed uniformly with a white pigmented membrane-forming compound (see [paragraph 2.1.6.B](#), above) immediately following the texturing operation. The curing compound shall be applied in 2 coats by hand.

Do not expose newly placed concrete for more than 30 minutes before being covered with curing compound. Failure to cover the surfaces of the concrete shall be cause for immediate suspension of the paving operations.

Perform application in accordance with manufacturer's directions but at a minimum rate of 100 to 150 square feet per gallon and not more than 350 square feet per gallon (total for both coats). Application shall be by a sprayer or long-nap roller and shall be an even, continuous membrane produced on the concrete surface. The second coat shall be applied in a direction approximately at right angles to the direction of the first coat. No puddling shall be produced. At the time of use, the compound shall be in a thoroughly mixed condition, with pigment uniformly dispersed through the vehicle. The compound shall form a uniform, continuous, coherent film that will not check, crack or peel and shall be free from pinholes or other imperfections.

The membrane shall harden 30 minutes after application. Personnel and equipment shall be kept off the freshly applied material to prevent damage to the seal. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected for 7 days from pedestrian and vehicular traffic and from any other action that might disrupt the continuity of the membrane. If the membrane becomes damaged within the initial 72 hours, damaged portions shall be repaired immediately with additional compound.

If removal of forms is required, exposed sections shall be protected immediately to provide a curing treatment equal to that provided for the surface.

- 2) **PE Film:** Spread the section of the film in a manner that will not damage the finished pavement surface. Securely tape or provide lap joints for the sections that are at least 12 inches wide and take suitable precautions to prevent the circulation of air beneath the film. Use black or dark plastic sheets when the daily high ambient temperature is between 40°F - 60°F. Use white opaque reflective plastic sheet when the daily ambient temperature is above 60°F. Plastic sheets shall meet the requirements of ASTM C171, *Standard Specification for Sheet Materials for Curing Concrete*.

Check the film for damage when it is spread and during the curing period. Repair or replace any damaged section immediately.

B. Cold Weather Concreting:

- 1) **Concrete temperature:** Concrete with a temperature of less than 55 degrees F will not be allowed to be placed. For coldweather concreting, comply with the requirements of ACI 306R, latest revision.
- 2) **Concrete Temperature:** Conform to the requirements of paragraph 420-7, Placing Concrete in Cold Weather of the NCDOT Standard Specifications for Roads and Structures, for the required temperatures of concrete.
- 3) **Cold subgrade:** No concrete is to be placed on a frozen subgrade.
- 4) **Rate of Temperature Change:** Keep changes in temperature of air immediately adjacent to concrete, during and immediately following curing period, as uniform as possible. Do not exceed a temperature change of 5 degrees F in any 1-hour or 50 degrees F in any 24-hour period.
- 5) **Curing – Normal Air Temperature Range: 40 to 85 degrees F:** Use liquid curing compound.
- 6) **Curing – Abnormal Air Temperature Range: Less than 40 degrees F:** No concrete is to be poured when the outside temperature is 40 degrees and falling unless measures are taken to insulate the concrete and otherwise protect the concrete for at least 3 days after the pour from freezing.
- 7) In cold weather applications, calcium chloride may be used as an admixture, if approved by the Town's Engineer, provided the concrete is not reinforced.

C. Hot weather concreting:

- 1) **Curing – Abnormal Air Temperature Range: Above 80 degrees F:**
 - a) When the outdoor temperature rises above 85 degrees F, comply with ACI 305R, latest amendment.
 - b) Verify proposed methods of proposed protection with the Town's Engineer before pouring concrete during high temperatures.
 - c) Routine hot weather measures: Routine measures for hot weather are cooling forms and wetting subgrade in addition to any of the other measures that may be employed to protect the concrete.

- d) Other measures for reducing temperature in concrete to aid in curing: Windbreaks, shading, fog spraying, sprinkling, ponding or wet covering with an approved light colored material.
- e) Take such protective measure as quickly as concrete hardening and finishing operations will allow.
- f) Set retarder: With the permission of the Town's Engineer, consider using set retarder admixtures along with curing compound.
- g) Cooling ready mix concrete: To reduce temperature during mixing, add ice into mix at plant. If trees are available, park waiting trucks in shade.

3.4.10 PAVEMENT PATCHING:

Where pavement patching is necessary, ensure work complies with following requirements.

- A. Pavement repair is to comply with [Standard Detail 9.06](#).
- B. Place pavement patch providing a thickened edge. Ensure that patch in plane of "cold" joint has a thickness 6 inches greater than that of the existing pavement. Extend patch under existing pavement for a distance of no less than 6 inches. Fill void under existing pavement full of concrete.
- C. Undercut existing pavement 6 inches all around patch and to a depth of 6 inches.
- D. Prior to placing patch, saw cut edge of existing pavement to 1/4 depth and remove pavement to provide a vertical face for a straight and true joint.
- E. Patch pavement as detailed and specified with concrete materials specified in this pavement section or as shown on drawings.

3.4.11 PROTECTION OF CONCRETE

- A. Protect new concrete sidewalks and appurtenances from pedestrian traffic for a minimum of 24 hours and do not open to pedestrian traffic for the first 5 days. Vehicular traffic shall be excluded for the first 14 days or until the minimum design compressive strength is attained, whichever is the lesser time.

Protect new concrete driveway surfaces and curb and gutter from vehicular traffic for minimum of 7 days or until the minimum design compressive strength is attained, whichever is the lesser time, unless otherwise approved by the Town's Engineer. Erect and maintain warning signs, lights, and watchmen to protect pedestrian and to direct traffic as needed.

- B. Repair or replace parts of pavement damaged by traffic or other causes occurring prior to final acceptance. Protect concrete pavement against public traffic, construction traffic and traffic caused by employees and agents.
- C. No equipment shall be driven or moved across newly paved surface unless such equipment is rubber-tired and only if paved surface is designed for and capable of sustaining loads to be imposed by the equipment.

- D. Do not drive over new or existing paved surfaces with tracked vehicles and equipment.
- E. Protect concrete from graffiti.

3.4.12 TESTING

A. Testing

- 1) **Initial Test:** The initial test (from first ready mix truck) is to be taken after the second yard is dispatched from the mixer and is to consist of the following:

- a. One slump test

APPLICATION	ALLOWABLE SLUMP
Hand poured Curb and Gutter	2" to 3 ½"
Machine formed Curb and Gutter	0-2" (see paragraph 3.1.2.E)
Other Applications	as specified by Town's Engineer

- b. Pull, prepare and store 3 cylinders on-site for 24 hours

- c. Temperature

- 2) **Second Test:**

After the above tests are pulled from the initial truck, every 5th truck thereafter is to be tested in the same manner as noted above.

- 3) **Subsequent Tests:** Slump tests may be required at any time during the pour if for any reason the Town Representative or Contractor feels the conditions of the concrete have changed. If the slump test fails, test cylinders of that section shall be taken by the Contractor.
- 4) The Engineer shall require any concrete that fails to meet the required compressive strength to be removed from any portion of a sidewalk, curb & gutter or driveway and that it be replaced at the contractor's expense.
- 5) **Testing Costs:** The cost of Quality Control (QC) tests, tests to assure the Contractor that he/she is meeting and complying with the requirements of these specifications, is the Contractor's responsibility. The cost of Quality Assurance (QA) tests, tests performed independently by the Town of Wake Forest to confirm that the Contractor is generally performing his/her work in compliance with these specifications, is the responsibility of the Town of Wake Forest.

3.4.13 DEFECTIVE WORK

The Town will require the removal and replacement of any concrete items where there are structural cracks, the concrete element has broken, has chips marring the appearance or mating of materials, have become misaligned, grades are incorrect, does not meet dimensions as shown in the Standard Details, improperly cured, or of a substandard or non-approved product. Such areas designated by the Town's Engineer shall be repaired at no cost to the Town. Items replaced shall conform to the

requirements for new work as to strength and construction. During removal of defective work, an amount equal to the required lengths of construction joints must be removed and replaced.

Both public and private paving jobs shall have cracked or defective curb replaced prior to paving.

The Town's Engineer may drill cores from completed slabs of concrete to obtain depth/thickness measurements. Sections showing a deficiency of more than 3/8 inch shall be removed and replaced to the specified depth at the Contractor's expense.

3.4.14 CLEAN UP

Ensure cleanup work is completed in a condition acceptable under these specifications within two weeks after pavement has been opened to traffic.

END OF SECTION 02400

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