SECTION 321613 - CONCRETE CURBS AND GUTTERS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

1. GENERAL
	* + 1. SUMMARY
				1. Section Includes Concrete Curbs and Gutters.
				2. Related Requirements:

Retain subparagraph below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.

[**Section 033000 "Cast-in-Place Concrete"**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete"**] for general building applications of concrete.

Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

* + - 1. REFERENCES
				1. American Concrete Institute

CP-1 Technician Workbook for ACI Certification of Concrete Field Testing Technician.

ACI 301 - Specifications for Structural Concrete

ACI 306.1 – Standard Specification for Cold Weather Concreting

ACI 318-19 – Building Code Requirements

* + - * 1. ASTM International

ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

ASTM A1017 - Standard Specification for Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum-Tungsten

ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C94 - Standard Specification for Ready-Mixed Concrete

ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C150 - Standard Specification for Portland Cement

ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete

ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete

ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

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 C595 - Standard Specification for Blended Hydraulic Cements

ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

ASTM C979 - Standard Specification for Pigments for Integrally Colored Concrete

ASTM C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars

ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete

ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation

ASTM C1116 - Standard Specification for Fiber-Reinforced Concrete

ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

* + - * 1. New York State Department of Transportation

DOT 501-3 – Construction Details

DOT 705-15 – Transverse Joint Supports

DOT 711-02 – Quilted Covers (For Curing)

DOT 711-05 – Membrane Curing Compound

DOT 713-03 – Fertilizer

* + - 1. DEFINITIONS

Retain terms that remain after this Section has been edited for a Project.

Definition in "Cementitious Materials" Paragraph below refers to materials that make up the cementitious component of the W/C ratio.

* + - * 1. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
				2. W/C Ratio: The ratio by weight of water to cementitious materials.
			1. PREINSTALLATION MEETINGS

Retain “Preinstallation Conference" Paragraph below if work of this Section is extensive or complex enough to justify a preinstallation conference.

* + - * 1. Preinstallation Conference: Conduct conference at [**Project site**].

Retain first subparagraph below if additional requirements are necessary; include information about conference.

Review methods and procedures related to concrete paving, including but not limited to, the following:

Concrete mixture design.

Quality control of concrete materials and concrete paving construction practices.

<**Insert agenda item**>.

Retain first subparagraph below if additional requirements are necessary; include information about conference.

Require representatives of each entity directly concerned with concrete paving to attend, including the following:

Retain subparagraphs below for representatives required to be present.

Contractor's superintendent.

Independent testing agency responsible for concrete design mixtures.

Ready-mix concrete manufacturer.

Concrete paving Subcontractor.

Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.

* + - 1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.

USE PARAGRAPH BELOW WITH EPD REQUIREMENT WHEN PROJECT ESTIMATE IS $1M OR MORE.

* + - * 1. Submit an Environmental Product Declaration (EPD) from the manufacturer for each concrete mix and steel reinforcement bar within this specification section, if available. A statement of the contractor’s good faith effort to obtain the EPD shall be provided if not available.

Manufacturer-provided EPDs must be Product Specific Type III (Third-Party Reviewed), in adherence with ISO 14025 *Environmental labels and declarations*, ISO 14044 *Environmental management – Life cycle assessment*, and ISO 21930 *Core rules for environmental product declarations of construction products and services.*

* + - * 1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
				2. Qualification Data: For qualified [**ready-mix concrete manufacturer**].

Retain "Material Certificates" Paragraph below for material certificates from manufacturers.

* + - * 1. Material Certificates: For the following, from manufacturer:

Cementitious materials.

Fiber reinforcement.

Admixtures.

Curing compounds.

Bonding agent or epoxy adhesive.

Joint fillers.

* + - * 1. Quality Control Submittals:

Data: Name and location of batch plant for concrete paving.

* + - * 1. Ready-Mix-Concrete Manufacturer Qualifications: Concrete batching plants shall be currently approved as concrete suppliers by the New York State Department of Transportation.

Retain subparagraph below, which is required by ACI 301 and ASTM C31. ASTM C1077 notes that relevant field or laboratory technician certification by ACI, NRMCA, the Portland Cement Association (PCA), or the national institute for certification in engineering technologies may demonstrate evidence of competence.

Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

* + - 1. PRECONSTRUCTION TESTING
				1. Preconstruction Testing Service: The Director’s Representative will engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.
			2. FIELD CONDITIONS
				1. Traffic Control: Maintain access for vehicular and pedestrian traffic as shown in the Contract Drawings.
				2. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with NYS DOT 502 and the following:

Place concrete when the air temperature of the subject area is 40 deg F and rising, or warmer, and when the surface temperature of the subject area is 40 deg F, or warmer.

Do not use frozen materials or materials containing ice or snow.

Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

* + - * 1. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

Retain last subparagraph above and option in subparagraph below if steel reinforcement is required.

Fog-spray forms and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

1. PRODUCTS
	* + 1. CONCRETE, GENERAL
				1. ACI Publications: Comply with ACI 301 unless otherwise indicated.
			2. FORMS
				1. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

* + - * 1. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.
			1. CONCRETE MATERIALS
				1. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

Generally retain first option in "portland cement" subparagraph below unless concrete with lighter shades or brighter colors is required. See the evaluations.

Portland Cement: ASTM C150, [**gray**] [**white**] Portland cement [**Type I**] [**Type II**] [**Type I/II**] [**Type III**] [**Type V**].

Retain one or both "Fly Ash" and "Slag Cement" subparagraphs below if supplementary cementing materials are permitted. Generally, delete both subparagraphs if using white portland cement. Ready-mix plants blend these materials with Portland Cement. Fly ash and slag cement may slow rate of concrete strengthening and affect color uniformity. Use of type C or type F fly ash may be determined by regional availability as well as by properties cited in ASTM C618.

Fly Ash: ASTM C618, Class F.

Slag Cement: ASTM C989, Grade 100 or 120.

Consider retaining last option below if damage caused by concrete expansion from alkali-silica or other chemical reactions is anticipated.

* + - * 1. Normal-Weight Aggregates: ASTM C33, Class 4S, uniformly graded. Provide aggregates from a single source on the NYS DOT Approved List of Sources of Fine and Coarse Aggregates.

Insert requirement for recycled content of coarse aggregate if required. Verify availability before specifying.

Use only crushed stone, crushed gravel, or crushed slag meeting the requirements of NYS DOT Section 703-02, Coarse Aggregates in either one or a combination of size designations specified in NYS DOT Table 703-4, Sizes of Stone, Gravel, and Slag and graded according to NYS DOT Table 501-2, Coarse Aggregate Gradations.

Retain "Fine Aggregate" subparagraph below to prohibit the exception in ASTM C33 that allows using reactive fine aggregate if low-alkali cement or reaction-inhibiting admixture is also required.

Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

* + - * 1. Air-Entraining Admixture: meeting ASTM C260 and appearing on the NYS DOT Approved List of Materials.
				2. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and appearing on the NYS DOT Approved List of Materials.

Retain one or more "Water-Reducing Admixture," "Retarding Admixture," "Water-Reducing and Retarding Admixture," "High-Range, Water-Reducing Admixture," "High-Range, Water-Reducing and Retarding Admixture," and "Plasticizing and Retarding Admixture" subparagraphs below.

Water-Reducing Admixture: ASTM C494, Type A and appearing on the NYS DOT Approved List of Materials.

Retarding Admixture: ASTM C494, Type B.

Water-Reducing and Retarding Admixture: ASTM C494, Type D and appearing on the NYS DOT Approved List of Materials.

High-Range, Water-Reducing Admixture: ASTM C494, Type F and appearing on the NYS DOT Approved List of Materials.

High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.

Plasticizing and Retarding Admixture: ASTM C1017, Type II.

* + - * 1. Water: Potable and complying with ASTM C94.
			1. FIBER REINFORCEMENT

Retain this article if fiber reinforcement is required.

* + - * 1. Fibrous Concrete Reinforcement: Collated Fibrillated type; ASTM C 1116 and ASTM C 1018, 100 percent virgin, homopolymer polypropylene fibers specifically manufactured for use as concrete reinforcement. Fiber Length: 3/4 to 1 1/2 inch. Specific Gravity: 0.9.

Grace Fibers by W.R. Grace & Company – Conn., Construction Products, 62 Whittemore Ave., Cambridge, MA 02140-1692, (877) 423-6491 www.na.graceconstruction.com.

Fibermesh by Propex Concrete Systems Corp., 6025 Lee Highway, Suite 425, PO Box 22788, Chattanooga, TN 37422, (800) 621-1273, www.fibermesh.com.

FORTA Econo-Mono by Forta Corporation, 100 Forta Dr., Grove City, PA 16127-6399, (800) 245-0306, www.fortacorp.com.

ProMesh Fibrillated Fibers by Pro Mesh Fiber Systems, Division of Canada Cordage Inc., 50 Ottawa St. S., Kitchener, Ontario, Canada N2G 3S7, (877) 224-2673, www.promesh.com.

Approved equivalent.

* + - 1. CURING MATERIALS
				1. Absorptive Cover: AASHTO M 182, [**Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry**] [**or**] [**cotton mats**].
				2. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
				3. Water: Potable.

Evaporation retarder in "Evaporation Retarder" Paragraph below temporarily reduces moisture loss from concrete surfaces awaiting finishing in hot, dry, and windy conditions. Evaporation retarders are not curing compounds or chemical surface retarders used to delay concrete setting.

* + - * 1. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

[Manufacturers:](http://www.specagent.com/Lookup?ulid=5172) Subject to compliance with requirements, provide products by one of the following:

[Kaufman Products, Inc](http://www.specagent.com/Lookup?uid=123457048320), (410) 354-8600, 3811 Curtis Ave, Curtis Bay, MD 21226

[Laticrete International, Inc](http://www.specagent.com/Lookup?uid=123457048322), (800) 243-4788, One LATICRETE Park, North Bethany, CT 06524-3423, USA

Sika Corporation, (800) 933-7452, 201 Polito Avenue, Lyndhurst, NJ 07071

Approved equivalent.

Retain "Clear, Waterborne, Membrane-Forming Curing Compound" Paragraph below if required. If appearance of paving is important before breakdown and disappearance of curing membrane, verify rate of dissipation with manufacturers.

* + - * 1. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating. The VOC content shall meet the requirements of the EPA national AIM VOC regulations and NYS DEC regulation 6 NYCRR Part 205 – “Architectural and Industrial (AIM) Coatings”.

[Products:](http://www.specagent.com/Lookup?ulid=5174) Subject to compliance with requirements, provide one of the following:

[Dayton Superior](http://www.specagent.com/Lookup?uid=123457048338); [**Clear Cure VOC J7WB**][**Clear Resin Cure J11W**][**Cure & Seal 309 EF**][**Cure & Seal 309 J18**].

[Kaufman Products, Inc](http://www.specagent.com/Lookup?uid=123457048340); DR Cure.

[Unitex by Dayton Superior](http://www.specagent.com/Lookup?uid=123457048351); Hydroseal 18.

Approved equivalent.

* + - 1. RELATED MATERIALS
				1. Joint Fillers: [**ASTM D1751, asphalt-saturated cellulosic fiber**] [**or**] [**ASTM D1752, cork or self-expanding cork**] in preformed strips.

Pigmented mineral dry-shake hardener in "Pigmented Mineral Dry-Shake Hardener" Paragraph below is nonmetallic and used because of its nonrusting characteristics for frequently wet concrete. This product is used to improve wear resistance and/or to color a concrete surface.

* + - * 1. Pigmented Mineral Dry-Shake Hardener: Factory-packaged, dry combination of portland cement, graded quartz aggregate, color pigments, and plasticizing admixture. Use color pigments that are finely ground, nonfading mineral oxides interground with cement.

[Products:](http://www.specagent.com/Lookup?ulid=5179) Subject to compliance with requirements, provide one of the following:

[Dayton Superior](http://www.specagent.com/Lookup?uid=123457048368); Quartz Tuff.

[Kaufman Products, Inc](http://www.specagent.com/Lookup?uid=123457048379); Tycron.

Approved equivalent.

Color: [**As indicated by manufacturer's designation**] [**Match** Director’s **Representative's sample**] [**As selected by Director’s Representative from manufacturer's full range**].

* + - 1. CONCRETE MIXTURES

Some authorities having jurisdiction prescribe concrete mixture requirements; revise this article to suit those requirements if any.

* + - * 1. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, at a NYS DOT-approved concrete batching plant.

Retain "Cementitious Materials" Paragraph below if applicable. ACI 301 sets no limits on amounts of cementitious or mineral admixtures that can replace Portland Cement unless concrete is exposed to deicing chemicals. Edit accordingly if Project has LEED goals.

* + - * 1. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland Cement in concrete as follows:

Fly Ash or Pozzolan: 20 percent.

Retain first Paragraph below if concrete paving will be exposed to freeze-thaw cycling or deicing chemicals or if other beneficial effects of air entrainment, such as workability or cohesion of concrete mixture, are required.

* + - * 1. 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:

Air Content: 6.5 percent plus or minus 1-1/2 percent.

* + - * 1. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
				2. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

Retain both subparagraphs below if required; revise to suit Project.

Use [**water-reducing admixture**] [**high-range, water-reducing admixture**] [**high-range, water-reducing and retarding admixture**] [**plasticizing and retarding admixture**] in concrete as required for placement and workability.

Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

Synthetic-fiber dosage rates in "Synthetic Fiber" Paragraph below reflect typical recommendations of manufacturers. Retain first option below for synthetic fiber used for reducing plastic shrinkage cracking; retain second option for synthetic fiber used for improving hardened concrete properties. Revise dosage if required.

* + - * 1. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than [**1.0 lb/cu. yd.**] [**1.5 lb/cu. yd.**].
				2. Concrete Mixtures: Normal-weight concrete.

Compressive Strength (28 Days): 5000 psi.

Generally retain first option in "Maximum W/C Ratio at Point of Placement" subparagraph below if concrete paving will be exposed to deicers or subject to freezing and thawing while moist; retain second option for concrete required to have low water permeability; insert another ratio to suit Project.

Maximum W/C Ratio at Point of Placement: 0.45.

* + - * 1. Slump Limit: 4 inches; before the addition of any water-reducing admixtures or high-range water-reducing admixtures at the site. When a water-reducing admixture is used, maximum slump shall be 6 inches and when a high range water reducing admixture is used maximum slump shall be 8 inches.

DELETE SECTION BELOW IF PROJECT ESTIMATE IS BELOW $1M OR STANDARD READY-MIX CONCRETE QUANTITY IS BELOW 50 CUBIC YARDS.

* + - * 1. Global Warming Potential Limits

The Global Warming Potential (GWP) of standard ready-mix concrete mixes shall meet the maximum limits outlined in in the table below. GWP of each mix will be verified through the submission of an EPD.

**Maximum Global Warming Potential (GWP) Limits**

**for Low Embodied Carbon Concrete**

|  |  |
| --- | --- |
| Specified compressivestrength (f'c in PSI) | Maximum Global WarmingPotential Limits for Low EmbodiedCarbon Concrete(kilograms of carbon dioxide equivalent percubic yard - CO2e kg/y3) |
| 0 - 2500 | 275 |
| 2501 - 3000 | 302 |
| 3001 - 4000 | 360 |
| 4001 - 5000 | 434 |
| 5001 - 6000 | 458 |
| 6001 - 8000 | 541 |
| 8000+ | N/A |

The maximum GWP limits are not applicable to quick cure concrete, concrete designed to cure to its design strength quicker than the standard 28 days.

* + - 1. CONCRETE MIXING

Retain option in "Ready-Mixed Concrete" Paragraph below if synthetic-fiber reinforcement is required.

* + - * 1. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94[**and ASTM C1116**]. Furnish batch certificates for each batch discharged and used in the Work.

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

Retain "Project-Site Mixing" Paragraph below if permitted. ACI 301 applies requirements in ASTM C94 to site-produced concrete.

* + - * 1. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94. Mix concrete materials in appropriate drum-type batch machine mixer.

For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.

For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

1. EXECUTION
	* + 1. EXAMINATION
				1. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
				2. Proceed with installation only after unsatisfactory conditions have been corrected.
			2. PREPARATION
				1. Remove loose material from compacted subbase surface immediately before placing concrete.
			3. EDGE FORMS AND SCREED CONSTRUCTION
				1. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
				2. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.
			4. JOINTS

Coordinate joint types, descriptions, and locations with drawings. Construction, isolation, and contraction joints and edging have been consolidated in this article for consistency rather than for strict sequence of installation.

* + - * 1. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
				2. Construction Joints: Set construction joints at side and end terminations of placement and at locations where placement operations are stopped for more than one-half hour unless paving terminates at isolation joints.

Retain one or more "Butt Joints," "Keyed Joints," and "Doweled Joints" subparagraphs below. Consider butt joints for joints not subject to traffic.

Butt Joints: Use [**bonding agent**] [**epoxy-bonding adhesive**] at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

Retain "Keyed Joints" subparagraph below for low-traffic areas if applicable. Keyed joints are incapable of significant load transfer at joint and are not recommended by ACI 302.1R for concrete less than 6 inches thick.

Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.

Retain "Doweled Joints" subparagraph below for load-transfer doweled joints. Revise if precoated dowels are required.

Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

* + - * 1. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

Expansion joints are types of isolation joints. Revise spacing in first subparagraph below to suit Project or delete if not required.

Locate expansion joints at intervals of [**50 feet**] unless otherwise indicated.

Extend joint fillers full width and depth of joint.

Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.

Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

* + - * 1. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated on the drawings or every ten linear feet for curbs. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows[**, to match jointing of existing adjacent concrete paving**]:

Widen top portion of sawed joint if joint sealants are required. Description below allows conventional wet- and dry-cut saws and if required depth of cut can be achieved, early-entry dry-cut saws.

Sawed Joints: Form contraction joints with power saws equipped with early entry, shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

Edging is included in this article because of its similarity to jointing. Timing of edging after initial floating is critical.

* + - * 1. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.
			1. CONCRETE PLACEMENT

Retain options in first two Paragraphs below if steel reinforcement is required.

* + - * 1. Before placing concrete, inspect and complete formwork installation[**, steel reinforcement,**] and items to be embedded or cast-in.
				2. Remove snow, ice, or frost from subbase surface[**and steel reinforcement**] before placing concrete. Do not place concrete on frozen surfaces.
				3. 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.
				4. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

Retain first Paragraph below if adding water is not permitted after batch mixing. ACI 301 and ASTM C94 permit water to be added to concrete mixture on-site to adjust slump, up to amount allowed in design mixture, with some limitations.

* + - * 1. Do not add water to concrete during delivery or at Project site unless specifically noted in approved mix design and on batch ticket. Do not add water to fresh concrete after testing.
				2. 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.
				3. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
				4. Screed concrete surface with a straightedge and strike off.
				5. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

Retain "Curbs And Gutters" Paragraph below if machine-placed curbs and gutters are permitted.

* + - * 1. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
			1. FLOAT FINISHING

Retain "General" Paragraph below. Some floating and troweling machines have watering attachments. Adding water weakens the concrete surface and can cause dusting and scaling.

* + - * 1. General: Do not add water to concrete surfaces during finishing operations.

Initial floating operation is included in "Concrete Placement" article.

* + - * 1. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

Smooth Rubbed Finish: Rub exposed face of curb to a smooth rubbed finish.

* + - 1. SPECIAL FINISHES

Retain "Pigmented Mineral Dry-Shake Hardener Finish" Paragraph below if required. Use compatible curing compounds in lieu of moisture curing to prevent discoloration and staining. Delete article if not required.

* + - * 1. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surface according to manufacturer's written instructions and as follows:

Option for rate of application in first subparagraph below is usually recommended for light traffic. Consult manufacturers and revise rate of application if required.

Uniformly spread dry-shake hardener at a rate of [**100 lb/100 sq. ft.**] unless greater amount is recommended by manufacturer to match paving color required.

Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.

After final power floating, apply a hand-troweled finish followed by a broom finish.

Coordinate curing compounds retained in part 2 for compatibility with pigmented mineral dry-shake hardener and, if required, revise list of manufacturers accordingly. Special curing compounds may be required.

Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.

* + - 1. CONCRETE PROTECTION AND CURING
				1. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
				2. Comply with NYS DOT 502 for cold-weather protection.

If evaporation rate in "Evaporation Retarder" Paragraph below is exceeded, ACI 305R states that plastic shrinkage cracking is probable. See manufacturers' literature or ACI 305R for estimated moisture-loss chart that relates relative humidity, air and concrete temperature, and wind velocity to rate of evaporation.

* + - * 1. 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.
				2. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

Retain one or more options in "Curing Methods" Paragraph below.

* + - * 1. Curing Methods: Cure concrete by [**moisture-retaining-cover curing**] curing compound as follows:

Retain one or more "Moisture-Retaining-Cover Curing," and "Curing Compound" subparagraphs below to suit Project. If retaining more than one, indicate locations of each curing method on drawings.

Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.

Do not use curing compound in "Curing Compound" subparagraph below on surfaces to be covered by unit pavers, tiles, or other materials set in mortar.

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.

* + - 1. FIELD QUALITY CONTROL
				1. Testing Agency: Director’s Representative will engage a qualified testing agency to perform tests and inspections.

Retain "Testing Services" Paragraph below to suit Project; delete if not required for small work.

* + - * 1. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172 shall be performed according to the following requirements:

Revise "Testing Frequency" subparagraph below to suit Project. First option is based on ACI 301, second on ACI 318 for slabs.

Testing Frequency: Obtain at least one composite sample for each [**100 cu. yd.**] [**5000 sq. ft.**] or fraction thereof of each concrete mixture placed each day.

Retain first subparagraph below with either option in "Testing Frequency" subparagraph above.

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.

Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

Air Content: ASTM C231, pressure method at point of placement; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.

Revise number of laboratory- or field-cured test specimens in "Compression Test Specimens" subparagraph below if required.

Compression Test Specimens: ASTM C31; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.

Coordinate number of compression test specimens in "Compression Test Specimens" subparagraph above with number of compressive-strength tests in "Compressive-Strength Tests" subparagraph below.

Compressive-Strength Tests: ASTM C39; test one specimen at seven days and two specimens at 28 days.

A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

* + - * 1. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
				2. Test results shall be reported in writing to Director’s Representative, 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.
				3. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Director’s Representative but will not be used as sole basis for approval or rejection of concrete.
				4. 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 Director’s Representative.
				5. Concrete paving will be considered defective if it does not pass tests and inspections.
				6. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
				7. Prepare test and inspection reports.
			1. REPAIR AND PROTECTION
				1. Remove and replace concrete curbing that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Director’s Representative.
				2. Drill test cores, where directed by Director’s Representative, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with Portland cement concrete bonded to paving with epoxy adhesive.
				3. Protect concrete curbing from damage.
				4. Maintain concrete curbing free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321613