
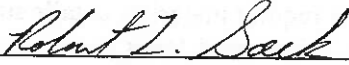


To: <b>SUPERSEDED BY</b> <u>EB 06-057</u> <b>EFFECTIVE 5/3/07</b>		New York State Department of Transportation <b>ENGINEERING          INSTRUCTION</b>	<b>EI</b> <b>04-019</b>
Title: REVISIONS TO STANDARD SPECIFICATIONS 502, 503, 608, 704, AND 705 FOR PORTLAND CEMENT CONCRETE (PCC) PAVEMENT AND ARCHITECTURAL PAVEMENT			
Distribution: <input checked="" type="checkbox"/> Manufacturers (18) <input checked="" type="checkbox"/> Local Govt. (31) <input checked="" type="checkbox"/> Agencies (32) <input type="checkbox"/> Surveyors (33) <input checked="" type="checkbox"/> Consultants (34) <input checked="" type="checkbox"/> Contractors (39) <input type="checkbox"/> _____ ( )	Approved:  Robert L. Sack Deputy Chief Engineer, Research Date: <u>7-APR-04</u>		

**ADMINISTRATIVE INFORMATION:**

- This Engineering Instruction (EI) is effective beginning with projects scheduled for the letting of September 9, 2004.
- No issuances are superseded by this EI.
- The shelf notes transmitted by this EI will be incorporated into the next revision of the Standard Specifications.

**PURPOSE:** The purpose of this EI is to:

- Transmit shelf notes for revised specifications for Portland Cement Concrete (PCC) Paving and related materials.
- Transmit shelf notes for revised specifications for sidewalk, driveway, and bicycle path paving.
- Create a new materials item for precast street pavers containing friction aggregate.
- Establish Section 601 as the appropriate location for architectural pavements and pavement treatments.
- Disapprove specifications for architectural pavement and pavement treatments which use the 608 root.

**TECHNICAL INFORMATION:** Related Design Guidance is being issued under EI 04-020, Design Guidance for Portland Cement Concrete (PCC) Pavement and Architectural Pavements.

**Section 502, Portland Cement Concrete Pavement.** In addition to several minor, nontechnical, or editorial revisions, the following changes were made to Standard Specification Section 502, Portland Cement Concrete Pavement.

**§502-2, Materials and Equipment.**

1. Class F concrete is no longer an acceptable substitute for Class C concrete. High-early-strength (HES) concrete is now an acceptable substitute for Class C concrete in situations where Class F would have previously been used.
2. Silicone joint sealants are now referenced by their specification number, 705-05.
3. Highway joint sealants are now referenced by their new ASTM designation, ASTM D 6690, Type IV.
4. The turnaround time for testing HES concrete has been increased to 45 days from 35 days.
5. Production diamond grinding equipment minimum head width has been increased to 1.2 m from 900 mm.
6. Drills may be either hydraulic or pneumatic. Hand-held drills are allowed for drilling into longitudinal joints in certain situations.
7. Added §502-2.04L, Air Blasting Equipment.

**§502-3, Construction Details.**

1. The contractor is required to place the subbase course wider to allow slipform paving equipment to operate on the same line and grade as the pavement is placed upon.
2. New edge slump requirements for slipform paving.

## EI 04-019 Page 2 of 5

3. New geometric requirements for slabs. Typical transverse joint spacing (slab length) has been reduced to 4.8 m from 5.0 m. Typical slab widths are now 3.66 m and 4.27 m to provide consistency between metric dimensioning and actual equipment capabilities.
4. Transverse hinge joints have been included as a new type of joint. They allow slabs to occasionally violate geometric requirements while maintaining tied longitudinal joints and consistent locations for expansion and contraction across the pavement width.
5. Longitudinal joint ties must now be fabricated into a joint assembly, much like transverse joint supports, for tied joints between lanes placed simultaneously. Also like transverse joint supports, these will require materials details submissions for acceptance.
6. Between slipformed lanes placed separately, longitudinal joint ties now must be one-piece bars drilled and anchored into the slipformed edge.
7. Multiple-piece longitudinal joint ties may still be used at fixed form joints between lanes placed separately. These joints must be keyed. Multiple-piece ties will also require materials details submissions for acceptance.
8. Longitudinal tining will become the standard macrotexture for PCC pavements having posted speeds of 40 mph or greater. Artificial-turf drag may be used on pavements with posted speeds less than 40 mph.
9. White-pigmented curing compound is now the standard curing method for all concrete placements unless cold weather temperatures apply. Table 502-3 has been eliminated.
10. The Contractor is required to temporarily fill first-stage saw cuts with jute or backer rod in newly placed concrete pavement if the new placement is going to be under consistent traffic. In the past, contractors were allowed to use newly placed PCC for construction traffic without any temporary filling. The construction traffic deposited too much debris into the joints in some instances, which caused minor chipping of the joints.
11. Contractors will now be allowed to reheat highway joint sealants, provided they recharge the melter with 20% fresh sealant.
12. New diamond grinding limits are in place based on recent experiences and texture orientation.

### **§ 502-5, Basis of Payment.**

1. New payment items for friction aggregates have been added.
2. New payment items for sealing joints with preformed joint sealer have been added.
3. The name of Item 502.9210 M has been changed to "Sealing Transverse Joints – Highway Joint Sealant."
4. Standard phrasing has been incorporated here, and in Method of Measurement, as well.

**Section 503, Portland Cement Concrete Foundation for Pavement, §705-14, Longitudinal Joint Ties, §705-15, Transverse Joint Supports.** These specifications have been rewritten in their entirety to better conform to state-of-the-practice PCC paving.

### **Section 601, Section 608, §704-08, §704-09, §704-13, §704-23, §704-24, §704-25**

1. Section 601 has been designated as the future location for standard specification for architectural paving products. Unlike products in Section 608, products to be included in this section will be acceptable for use under vehicle traffic.
2. Currently Section 601 contains no standard items; however, many special specifications exist which should reference the 601 root.
3. Section 601 is designated for architectural pavement treatments to assist designers in including architectural elements, which have been evaluated for safety and durability under traffic in Department projects, and keep these items separate from architectural treatments for sidewalks, driveways, bicycle paths, etc.
4. Revisions to Subsections 704-08, 704-09, and 704-13 clarify the intention of these items for use in nontraffic areas. Subsection 704-23 is a new item which has been created with friction aggregate requirements. This material may be referenced in special specifications, with the 601 root, which are intended for use as context sensitive solutions for pavement applications. Design guidance is provided in

## EI 04-019 Page 3 of 5

- EI 04-020, Design Guidance for Portland Cement Concrete (PCC) Pavement and Architectural Pavement.
5. All item and paragraph titles in Section 608, and §704-08, §704-09, and §704-13 have been changed to clarify that these products are for sidewalks, driveways, and bicycle paths only.
  6. All special specifications which use the 608 root and are intended for use in pavements are disallowed by this EI and must be reissued using the 601 root number, and must identify the appropriate aggregate requirements for friction in their title. Design guidance is provided in EI 04-020, Design Guidance for Portland Cement Concrete (PCC) Pavement and Architectural Pavements.
  7. All special specifications which use the 608 root and do not specifically reference sidewalks, driveways, and/or bicycle paths in their title are disallowed by this EI.
  8. If the disapproved specification is intended for use in pavements it must be reissued using the 601 root number and must identify the appropriate aggregate requirements for friction in its title. Design guidance is provided in EI 04-020, Design Guidance for Portland Cement Concrete (PCC) Pavement and Architectural Pavements.
  9. If the disapproved specification is not intended for use in pavements it must be reissued with its intended area of use clearly defined in its title, e.g., "Sidewalks, Driveways, and Bicycle Paths."
  10. No cost impact is expected due to the designation of Section 601 as the location for architectural pavement products.

### IMPLEMENTATION:

- The Design Quality Assurance Bureau will insert the transmitted shelf notes into contract proposals beginning with projects scheduled for the letting of September 9, 2004.
- The following specifications are disapproved by this EI.

502.RPC0 M            PCC Pavement...

<u>R-Pavement &amp; Reinforcement</u>	<u>P – Profilographing</u>	<u>C – Concrete Class</u>
0 – Unreinforced	0 – Nonprofilographed	1 – Class C
1 – Isolated, Mesh Reinforced	1 – Level 1	2 – Class F
2 – Isolated, Heavy Reinforced	2 – Level 2	3 – Class HES

91502.XXX0 M	Portland Cement Concrete Pavements Utilizing the Concrete Maturity Method
503.0101 M	Cement Concrete Foundation for Pavement, Unreinforced, Class C,
503.02 M	Cement Concrete Foundation for Pavement, Unreinforced, Class F
11608.0101 M	Washed Riverstone Concrete Surfacing
04608.0111 M	Exposed Aggregate Concrete Surfacing (One Course Method)
02608.0112 M	Exposed Aggregate Concrete Surfacing
10608.0196 M	Color Tinted Concrete Paving for Crosswalks
11608.0196 M	Color Tinted Concrete Paving
02608.03 M	Precast Concrete Pavers on Existing Subbase
09608.03 M	Precast Concrete Pavers
10608.05 M	Bluestone Paving with Sand Joints (Sand Setting Bed on Concrete Slab)
04608.10 M	Precast Concrete Pavers
05608.12 M	Precast Concrete Paving (Bituminous Setting Bed)
11608.15 M	Granite Modular Pavers
11608.31 M	Granite Pavers
09608.4004 M	Furnishing Paving Stone (Bluestone)
04608.9301 M	Colored and Imprinted Horizontal Concrete Surfaces
10608.9318 M	Colored and Imprinted Concrete Surfaces, 100 mm Thick
10608.9320 M	Colored and Imprinted Concrete Surfaces, 150 mm Thick
10608.9322 M	Colored and Imprinted Concrete Surfaces, Variable Thickness
10608.9401 M	Streetprint Asphalt Pavement Color/Texture System
03608.9402 M	Streetprint Pavement Texturing System (Vehicular Area)
08608.9402 M	Streetprint Pavement Texturing System (Vehicular Area)
01608.9503 M	Integrally Colored Hot Applied Synthetic Asphalt Wearing Surface
10608.9503 M	Integrally Colored Hot Applied Synthetic Asphalt Wearing Surface

## EI 04-019 Page 4 of 5

- The following new specifications are created by this EI.  
502.RPCF M PCC Pavement...

<u>R-Pavement &amp; Reinforcement</u>	<u>P – Profilographing</u>	<u>C – Concrete Class</u>	<u>F - Friction</u>
0 – Unreinforced	0 – Nonprofilographed	1 – Class C	1 – Type 1
1 – Isolated, Mesh Reinforced	1 – Level 1	2 – Class F	2 – Type 2
2 – Isolated, Heavy Reinforced	2 – Level 2	3 – Class HES	3 – Type 9
			9 – Type 9

503.1010 M	PCC Foundation for Pavement, Class C
503.1011 M	PCC Foundation for Pavement, Class F
503.1012 M	PCC Foundation for Pavement, HES Concrete
503.9110 M	Constructing Longitudinal Joints in Foundation Pavement
704-23	Precast Concrete Street Pavers

### **TRANSMITTED MATERIALS:** The following shelf notes are attached to this EI.

Section 502	Portland Cement Concrete Pavement
Section 503	Portland Cement Concrete Foundation for Pavement
Section 608	Sidewalks, Driveways, and Bicycle Paths
§704-08	Brick Pavers for Driveways, Sidewalks, and Bicycle Paths
§704-09	Stone Blocks for Driveways, Sidewalks, and Bicycle Paths
§704-13	Precast Concrete Pavers for Driveways, Sidewalks, and Bicycle Paths
§704-23	Precast Concrete Street Pavers
§705-14	Longitudinal Joint Ties
§705-15	Transverse Joint Supports

**BACKGROUND:** Several pavement sections constructed in recent years with Class F concrete have been identified as having friction below the Department's design target, even though the concrete contained appropriate friction aggregate. The high cement content and low sand content of Class F make it an undesirable and uneconomical mix for paving. HES mixtures, designed by the contractor, should provide better performance at more economical prices than Class F concrete.

With the introduction of multiple types of friction aggregate requirements, based on friction demand, revisions to pay item numbers for PCC wearing surface pay items were needed. The attached shelf notes contain modified pay item numbers for these items so that designers may easily identify the appropriate friction type. Design guidance for selecting the appropriate friction aggregate type will be issued separately in EI 04-020, Design Guidance for Portland Cement Concrete (PCC) Pavement and Architectural Pavements.

The changes related to friction and texture have been developed in cooperation with: New York Construction Materials Association, American Concrete Pavement Association, New York City Concrete Promotional Council, and Federal Highway Administration.

**REFERENCES:** The following references were used to develop the revised PCC pavement texture requirements. The new requirements for friction aggregate were developed based on research performed by the Materials Bureau. The results of the research are expected to be published in the near future.

*A Fact Finding Study on the Effects of Grooved and Textured Pavements on Motorcycles*, State of California Department of Public Works (ordered by State Senate), 1973

Apostolos, et-al (CA), *California Skid Resistance Studies, Final Report*, CalTrans, 1974

Ardani & Outcalt (CO), *PCC Texturing Methods*, CODOT, 2000

Farnsworth & Johnson, *Reduction of Wet Pavement Accidents on Los Angeles Metropolitan Freeways*, CalTrans, 1971

## EI 04-019 Page 5 of 5

- Kuemmel et-al, *Noise and Texture on PCC Pavements, Results of a Multi-state Study*, Wisconsin, 1999
- Larson & Hibbs, HNG-42, PCC Surface Texturing Issues, FHWA, 1995
- Morgan, *Effects of PCC Pavement Texturing on Pavement Friction and Noise*, CR 87, NYSDOT, 2003
- Neal, et-al, *Portland Cement Concrete Pavement Texture Quality*, CalTrans, 1975
- Neal, et-al, *Surface Textures for PCC Pavements*, CalTrans, 1975
- Neal, *An Evaluation of PCC Pavement Tine Texturing Patterns*, CalTrans, 1985
- Rasmussen, *Pavement Surface Texturing and Restoration for Highway Safety*, IGGA, Presented at 53<sup>rd</sup> Annual Skid Resistance Symposium, HRR, 1974 Study, 2000
- Smith & Elliott, *Evaluation of Minor Improvements, Grooved Pavement (Supplemental Report) part 8*, CalTrans, 1978
- Spellman et-al, *Effect of Broom Texture on Motorcycle Rideability, Interim Report*, CalTrans, 1972

**CONTACT:** For additional information regarding the new requirements for friction aggregate and pavement texture, contact Brad Allen of the Materials Bureau at (518) 457-3240, or [ballen@dot.state.ny.us](mailto:ballen@dot.state.ny.us). For additional information related to Section 601 or Section 608, contact Robert Lohse of Landscape Architecture Bureau at (518) 457-3528, or [rlohse@dot.state.ny.us](mailto:rlohse@dot.state.ny.us). For any other information related to this EI, contact Bill Cuerdon of the Materials Bureau at (518) 457-3240, or [wcuerdon@dot.state.ny.us](mailto:wcuerdon@dot.state.ny.us).

Make the following changes to the Standard Specifications of January 2, 2002.

**Pages 5-18 to 5-39**

**Delete** Section 502, Portland Cement Concrete Pavement, in its entirety and the Errata Issued with Prop Makeup for 7/11/02 and **replace** them with the following.

**“SECTION 502 - PORTLAND CEMENT CONCRETE PAVEMENT**

**502-1 DESCRIPTION.** Construct a portland cement concrete (PCC) pavement and shoulders, if required, as detailed in the contract documents.

**502-2 MATERIALS AND EQUIPMENT**

Portland Cement Concrete	501
Anchoring Materials - Chemically Curing	701-07
Silicone Joint Sealants	705-05
Premoulded Resilient Joint Filler	705-07
Preformed Elastic Longitudinal Joint Seal	705-10
Preformed Elastic Transverse Contraction and Expansion Joint Seal	705-12
Lubricant for Preformed Elastic Joint Sealer	705-13
Longitudinal Joint Ties	705-14
Transverse Joint Supports	705-15
Wire Fabric for Concrete Reinforcement	709-02
Epoxy Coated Bar Reinforcement, Grade 420	709-04
Quilted Covers (for curing)	711-02
Plastic Coated Fiber Blankets (for curing)	711-03
Polyethylene Curing Covers (white opaque)	711-04
Membrane Curing Compound	711-05
Form Insulating Materials for Winter Concreting	711-07
Water	712-01
Highway Joint Sealants	ASTM D 6690, Type IV
Backer Rods	ASTM D 5249

In addition to meeting the requirements of ASTM D 5249 (Type 1 or 3), backer rods must be closed cell polyethylene foam with a diameter at least 25% wider than the second-stage saw cut.

In addition to meeting the requirements of §701-07, Anchoring Materials - Chemically Curing, the material used to anchor longitudinal joint ties, dowels, or other miscellaneous items into hardened concrete must be a pourable, two-component, 100% solids structural epoxy dispensed:

- From side-by-side cartridges by manual or pneumatically powered injection guns.
- Through a static mixing nozzle that homogeneously mixes the material without any hand mixing.

The Department may perform supplementary sampling and testing of the silicone and highway joint sealants. Deliver sealant in the manufacturer's original sealed container legibly marked with the:

- Manufacturer's name.
- Trade name of the sealant.
- Manufacturer's lot or batch number.
- Pouring temperature (Highway Joint Sealant only).
- Safe heating temperature (Highway Joint Sealant only).

**502-2.01 Concrete.** Use Class C concrete furnished in accordance with Section 501, Portland Cement Concrete – General, when specified. High-Early-Strength (HES) concrete, meeting the requirements of §502-2.02, may be substituted for closure or short placements, subject to the Engineer’s approval.

**502-2.02 High-Early-Strength (HES) Concrete.** Use HES concrete where required in the contract documents or where the Contractor’s request to use HES concrete is approved by the Department. Whether required or requested, design the HES mix to satisfy the opening to traffic time requirements of the project and Table 502-1, High-Early-Strength Concrete Mix Requirements. Submit the HES concrete mix design to the Engineer. Include admixture brands and dosages as well as mixing, transporting, placing, paving, curing, and anticipated strength gain details.

Produce and place a 3.0 m<sup>3</sup> (minimum) trial batch at an off-contract location selected by the Contractor and agreed upon by the Engineer. Produce the trial batch using the same materials and processes as those to be used to produce concrete for the contract. Provide the Engineer a 7-day minimum advance notification of trial batch production. Produce and place the trial batch in the presence of the Engineer, the Regional Materials Engineer, and Materials Bureau personnel.

Provide an American Concrete Institute (ACI) Certified Concrete Field Testing Technician, Grade I, or higher, to:

- Measure slump, air content, and unit weight of the trial batch.
- Cast cylinders from the trial batch for compressive strength and freeze-thaw resistance testing.

Determine the compressive strength of the trial batch concrete at the desired time as discussed in §502-3.18C, Project Strength Determination.

The Materials Bureau will render a decision on mix acceptability, curing, and opening to traffic requirements within 45 calendar days of trial batch production. Changes other than minor fluctuations in admixture dosage rates require a new mix design and trial batch. The Engineer will reject the concrete if the specified slump or plastic air content are not achieved. The Engineer may halt paving and order additional trial batches whenever the specified compressive strength requirements are not achieved.

<b>TABLE 502-1 HIGH-EARLY-STRENGTH CONCRETE MIX REQUIREMENTS</b>			
<b>Property</b>	<b>Minimum</b>	<b>Desired</b>	<b>Maximum</b>
28 Day Compressive Strength	28.0 MPa	-	-
Opening Compressive Strength	17.0 MPa <sup>1</sup>	-	-
Plastic Air Content	5.0 %	6.5 %	8.0 %
Hardened Air Content	5.0%	6.5 %	8.0 %
Water – Cement Ratio (w/c)	-	-	0.44
Slump <sup>2</sup>	25 mm	-	150 mm

**NOTES:**

1. See §502-3.18, Opening to Traffic.
2. Minimum slump provided the mix consolidates and finishes properly. Maximum slump provided the mix is nonsegregating.

**502-2.03 Portland Cement Treated Permeable Base (PCTPB).** Use (1) coarse aggregate meeting §501-2.02B2, Coarse Aggregate, with Type CA2 gradation, (2) portland cement, Type I, II, or I/II meeting §701-01, Portland Cement, and (3) water in the following proportions:

Cement	143 kg/m <sup>3</sup>
Aggregate	1600 kg/m <sup>3</sup>
w/c	0.37 max

Aggregate weight is based on a bulk density of 1600 kg/m<sup>3</sup> and a saturated, surface-dry condition determined in accordance with AASHTO T 19M, Bulk Density ("Unit Weight") and Voids in Aggregate. Adjust the aggregate weight accordingly if the contract aggregate has a different bulk density.

Use saturated, surface-dry coarse aggregate if PCTPB is brought to the site in open haul units. Coarse aggregate for PCTPB do not have to meet friction requirements.

**502-2.04 Equipment.** Provide the Engineer with an equipment list and specifications a minimum of 14 days prior to the planned start of PCC paving. Bring all equipment needed to place, consolidate, finish, texture, cure, saw cut, seal, and test the PCC pavement and permeable base to the job site a minimum of 1 full work day before its use to allow examination by the Engineer. Repair or replace any equipment found to be defective before or during its use. Discontinue any operation if unsatisfactory results are being obtained. Use of equipment other than described below is subject to the approval of the Director, Materials Bureau.

**A. Slipform Paving.** Use a self-propelled slipform paver equipped with:

- Rigid side forms that laterally support the concrete and minimize edge slumping.
- A full-width finishing pan.
- Attached internal vibrators capable of consolidating the entire concrete placement.

Slipform paving consists of a single paver, or a placer/spreader followed by a separate paver, capable of placing, spreading, consolidating, screeding, and finishing the concrete such that hand finishing is kept to a minimum. Use equipment guided by a reference system that ensures the pavement is placed to the specified line, grade, and cross section.

**B. Fixed Form Paving**

**1. Forms.** Use straight forms without horizontal joints meeting Table 502-2, Form Requirements, and equipped with:

- At least 3 stake pockets spaced 1.0 m apart (maximum), each having a positive, nondetachable wedge.
- Positive, interlocking devices capable of holding abutting sections together to form neat, tight joints.

Flexible, curved, or wooden forms may be used in irregular areas or curved sections having horizontal radii of 30 m or less.

**2. Paving Equipment.** Use a self-propelled paver equipped with a full-width finishing pan and attached internal vibrators capable of consolidating the entire concrete placement. Three (3) full-width transverse finishing screeds may be used in lieu of the full-width finishing pan. When 2 pavers are used to employ 3 transverse screeds, vibrate with the first paver only.

Finishing machines with double cylinders and augers capable of rotating in opposite directions, attached internal vibrators, and at least 1 pan float may also be used. However, if the pavement is specified as nonprofilographed, §502-3.16, Profilograph, and §502-3.17, Diamond Grinding, will apply. §502-3.15, Hardened Surface Test, will not apply.

Fixed form paving consists of 1 or 2 pavers, or a placer/spreader followed by the paver(s), capable of placing, spreading, consolidating, screeding, and finishing the concrete to the specified line, grade, and cross section such that hand finishing is kept to a minimum.

TABLE 502-2 FORM REQUIREMENTS	
Characteristic	Requirement
Material	Steel, 6 mm thick, minimum.
Length	3.0 m, minimum.
Depth	Equal to the sum of the edge thicknesses of all pavement layers placed within the form.
Base Width	Equal to the depth, minimum.
Horizontal Top Face	50 mm wide, minimum, and lying in a plane with a maximum variation of 3 mm in 3.0 m.
Vertical Face	Maximum variation of 6 mm in 3.0 m and rounded on the upper corner with a 20 mm radius, maximum.
Flange Bracing	Extends outward on the base $\frac{2}{3}$ of the form depth, minimum.

**3. Paving Irregular Areas.** Pave with the following equipment, in order of preference, if slipform or fixed form paving equipment cannot be used in an irregular area:

- a. Triple tube roller pavers.
- b. Concrete finishing machines equipped with internal vibrators and double cylinders and augers capable of rotating in opposite directions and at least 1 pan float.
- c. Roller pavers.
- d. Manual, vibrator equipped power screeds appearing on the Department's Approved List.
- e. By hand.

**C. Vibrators.** Use paver-mounted internal vibrators capable of consolidating the entire concrete placement that are:

- Capable of being shut off without shutting off the paver.
- Equipped with frequency controls readily accessible to the paver operator.
- Capable of simultaneously operating at the same frequency as the other paver-mounted vibrators.
- Capable of operating through a frequency range of 6,000 - 10,000 vibrations per minute.

Check vibrator operating frequencies daily when paving begins. Check frequencies under load with the Engineer present. If the paver is not equipped with direct-read frequency gauges for each vibrator, supply the Engineer with a calibrated, hand-held tachometer, including instructions, to monitor vibrator frequencies. The tachometer will remain the Contractor's property after paving is complete.

Use hand-held vibrators capable of operating through a frequency range of 6,000 - 10,000 vibrations per minute in irregular areas or at any location that is not consolidated by internal vibrators attached to the paving equipment.

**D. Permeable Base Paving Equipment.** Use pavers meeting §502-2.04A, Slipform Paving, with vibrators disengaged or §402-3.02, HMA Pavers, with an attached vibrating screed. Permeable base may be placed by hand and compacted with plate or small drum vibrators in fixed form operations with permeable base placed within the forms or in areas not accessible to pavers.

**E. Saw Cutting Equipment.** Use diamond blade saws capable of making straight cuts to the dimensions depicted in the Standard Sheets that are equipped with cutting guides, blade guards, water cooling systems, dust controls, and cut depth control. Where beveled saw cuts are required, use a cutting or grinding device attached to the saw blade, or a separate device following the saw.

Maintain equipment and supplies to ensure uninterrupted saw cutting. Early entry saws require approval from the Director, Materials Bureau. Submit requests to use early entry saws at least 7 calendar days before paving.

**F. Curing Compound Applicators.** Use atomizing mechanical sprayers capable of exerting consistent pressure without hand pumping that are equipped with tank agitators to continuously mix the curing compound. Use nozzles with spray shields to prevent drift. Flush nozzles daily before use. Maintain equipment and supplies, including extra nozzles, to ensure uninterrupted curing compound application. In a slipform paving operation, use self-propelled applicators guided by the same reference system as the slipform paver. In a fixed form operation, applicators need not be self-propelled.

**G. Profilograph.** For projects with profilograph smoothness requirements, use an automated California-type profilograph capable of producing and analyzing a profile trace in accordance with Materials Method 24, Portland Cement Concrete Pavements Profilograph Operations. Use automation capable of reporting profile indices in mm/km using a 5 mm blanking band and in mm/km using a zero blanking band.

**H. Diamond Grinding.** Use equipment having gang-mounted diamond saw blades on a multiblade arbor specifically designed for pavement bump cutting or production grinding. When production grinding, use equipment capable of producing a 1.2 m (minimum) grinding pass width that is equipped with a vacuum system capable of removing slurry from the pavement surface. Use blade spacers having a minimum thickness of 2.67 mm. Inform the Engineer of the spacer thickness selected.

**I. Drills.** Use gang drills with a minimum of 2 independently powered and driven drills. Use tungsten carbide drill bits. Rest and reference the drill rig frame on and to the pavement surface such that the drilled holes are cylindrical, perpendicular to the surface being drilled, and repeatable in terms of position and alignment. Hand-held drills, or gang drills resting on the permeable base or subbase, are permitted for drilling holes in longitudinal joints if there is not enough room to use gang drills resting on the pavement surface. This typically occurs when traffic is being maintained on a previous placement.

**J. Joint Sealing – Silicone Joint Sealant.** Use equipment that pumps the silicone directly from plastic pails or drums by compressed air powered extrusion pumps designed for moisture curing silicone sealants. Use teflon seals and packing and teflon lined hoses to prevent moisture permeation. Use nozzles that apply the silicone within the joint confines for the full width of the joint, and to the level below the pavement surface depicted in the Standard Sheets.

**K. Joint Sealing – Highway Joint Sealant.** Heat the sealant in a melter constructed either:

- As a double boiler with the space between inner and outer shells filled with oil or other heat-transfer medium.
- With internal tubes or coils carrying the sealant through a heated oil bath and into a heated double-wall hopper.

Do not use direct heating. Use a melter capable of maintaining the sealant's pouring temperature and providing homogeneous sealant equipped with:

- Positive temperature control.
- Continuous full sweep mechanical agitation.

- Separate thermometers indicating the temperatures of the heat transfer medium and the sealant in the hopper. Do not place any sealant if the thermometers are defective or missing.

Provide 2 thermometers having stems 450 mm long and temperature ranges sufficient to meet the requirements of this specification. Use a discharge hose equipped with a controlled heating apparatus or sufficiently insulated to maintain the proper sealant pouring temperature. Use nozzles that apply the joint sealant within the joint confines for the full width of the joint, 5 mm – 10 mm below the pavement surface.

**L. Air Blasting Equipment.** Use equipment with traps or other installed devices that prevent moisture and oil from contaminating the concrete surface. Use a compressor that delivers air at a minimum of 3.4 m<sup>3</sup> per minute and develops a minimum nozzle pressure of 0.62 MPa. Check the compressed air stream purity daily with a clean white cloth.

**502-3 CONSTRUCTION DETAILS.** Convene a prepaving meeting 7 to 14 days before the planned start of PCTPB paving with the Engineer and any PCC paving and saw cutting subcontractors to coordinate all aspects of paving and inspection, including equipment review, construction methods, and time and personnel requirements.

Construct a smooth, well consolidated, properly finished, textured, and cured pavement to the line and grade depicted in the contract documents,  $\pm$  6 mm vertically at any location.

#### **502-3.01 Weather Limitations**

**A. Rain.** Do not pave in the rain. Supply sufficient quilted covers, plastic coated fiber blankets, or polyethylene curing covers near the paving operation when rain may be expected. Securely cover any concrete exposed to rain that has not reached initial set or will be visibly affected by the rain.

**B. Cold Weather.** Place concrete when the air temperature is 4°C and rising, or warmer, and when the surface temperature of the area to be paved is 4°C, or warmer. Stop paving when the air temperature falls below 4°C. Measure temperatures in the shade to an accuracy of  $\pm$  1°C. Refer to §502-3.11C, Cold Weather Curing.

**502-3.02 Subbase Course.** Furnish in accordance with Section 304, Subbase Course, before placing any PCTPB or PCC. If the subsequent PCC placement is a profilographed traveled way and the area is available, widen the prepared subbase course at the same line, grade, and cross slope such that it is at least:

- 1.0 m beyond the longitudinal edges of a slipform pavement.
- 300 mm beyond the outside longitudinal edges of the fixed forms.

Additional subbase course that is not included in the finished work will be paid for under Section 304 items included in the contract.

**502-3.03 Portland Cement Treated Permeable Base.** Apply §502-3.01, Weather Limitations. Place and consolidate permeable base within 2 hours of water addition to the mix. Allow to air cure for a minimum period of time such that concrete placement results in no damage to the permeable base.

Place permeable base on a prepared subbase course to the dimensions depicted in the contract documents such that the final surface elevation does not vary more than 6 mm above or 25 mm below the design grade elevation at any location. In a slipform paving operation, test the surface both perpendicular to the pavement centerline and diagonally across the pavement using a stringline placed across the referencing system. Test the surface (1) at the beginning of each day's placement, (2) every 15 m

thereafter, (3) at the end of each day's placement, and (4) wherever required to ensure reasonably close conformance to the contract documents. In a fixed form paving operation, use a scratch board placed transversely across the forms to continuously test the surface elevation and verify the appropriate concrete thickness will be placed. Trim excess permeable base from high areas exceeding 6 mm in 3 m before it hardens. Build up low areas deeper than 25 mm in 3 m with CA 1 or CA 2 coarse aggregate.

In a slipform paving operation, place the permeable base slightly wider than the pavement width being placed. Remove and replace permeable base placed wider than the pavement if it is damaged or contaminated.

In a fixed form paving operation, place permeable base either within the forms or beneath the forms. When placing within forms, place a bead of commercial masonry caulk along the top surface of the permeable base at the form interface before placing concrete to prevent paste infiltration down the vertical face of the form. The masonry caulk bead is not required at placement edges outside of the underdrains.

Construction traffic may be maintained on permeable base in areas of limited access. Remove and replace damaged or contaminated permeable base before placing PCC.

**502-3.04 Slipform Paving.** Establish a reference system to achieve the specified smoothness level. If string lines are used, set them by survey and use dual lines for the initial placement if it is a profilographed traveled way and the area is available.

Maintain uniform concrete quality and head in front of the paver. Coordinate concrete delivery to maintain continuous forward movement of the paver and avoid excessive delivery truck queues. Keep paver tracks clear of concrete and debris before and during paving.

If concrete is placed directly on subbase, i.e., there is no permeable base, wet the entire subbase surface without forming puddles or mud immediately before placing concrete.

Whenever possible, unload concrete into a mechanical spreader that deposits it near the final position before paving. If a spreader is not used, uniformly distribute the concrete in front of the paver by maneuvering the delivery truck chute.

Consolidate the entire concrete placement using internal vibrators attached to the machine. Combine paver forward speed, vibrator frequency, and vibrator depth to consolidate the concrete without segregation, vibrator trails, or contacting the joint assemblies. Discontinue vibration and tamping if the paver stops.

Determine edge slump by extending a 600 mm (minimum) long straightedge over the longitudinal pavement edges. Immediately correct edge slumps greater than 6 mm that are between concrete placements and greater than 10 mm at free edges and HMA shoulders.

### **502-3.05 Fixed Form Paving.**

**A. Setting Forms.** Compact the supporting layer at the form line such that the forms are supported for their full length. Set forms to string lines placed at the pavement elevation, line, and grade and to achieve the specified smoothness. If a form sits above the string line, remove the form and trim the form line to the proper grade. If a form sits below string line, remove the form and fill and compact the low area with granular material at least 150 mm on both sides of the form. Frequently check form grade and alignment while paving. Reset forms as necessary.

Set forms to accommodate a full days paving before placing concrete. Extend forms beyond construction bulkheads to provide a working platform at the end of a placement. Secure each form with a minimum of 3 pins each of sufficient length to hold the forms in place without movement during any operation. Lock the forms together such that the form ends are aligned and the joints are tight and smooth. Run the paving equipment atop the forms before placing any concrete and recheck form alignment. Reset forms as necessary.

Align keyway strips in a smooth, horizontal plane, parallel to the top of the form. Match keyway strips on abutting forms such that a nearly seamless keyway results.

**B. Paving.** Apply oil to forms before placing concrete. Immediately before placing concrete, wet the entire subbase or permeable base surface without forming puddles or mud. Whenever possible, unload concrete into a mechanical spreader that deposits it near the final position before paving. If a spreader is not used, uniformly distribute the concrete in front of the paver by maneuvering the delivery truck chute.

Maintain uniform concrete quality and head in front of the paving machine and without running over the screeds. Coordinate concrete delivery to maintain continuous forward movement of the paver and avoid excessive delivery truck queues. Keep form tops clean before and during paving.

Consolidate the entire concrete placement using internal vibrators attached to the paver. Combine paver forward speed, vibrator frequency, and vibrator depth to consolidate the concrete without segregation, vibrator trails, or contacting the joint assemblies. Discontinue vibration and tamping if the paver stops.

Mark the midpoint ( $\pm 10$  mm) of each transverse contraction joint with a shim placed into the plastic concrete immediately adjacent to each form. Use shims equal in width and depth to the contraction joint first-stage saw cuts depicted in the Standard Sheets. Set the shims perpendicular to the forms and the pavement surface. Make first-stage saw cuts from shim to shim as discussed in §502-3.06A1, Transverse Contraction Joints. Use shims of sufficient lengths to allow complete first-stage saw cutting to each shim without striking the form.

**C. Paving Irregular Areas.** Uniformly spread concrete. If concrete is spread by hand, use come-alongs or shovels. Do not use rakes or hand-held vibrators to spread concrete. Use hand-held vibrators ahead of the paving equipment to consolidate all concrete not vibrated by equipment-mounted internal vibrators. Keep hand-held vibrators perpendicular to the pavement surface. Vibrate between 2 and 4 seconds in each location, overlapping adjacent locations. Do not drag hand-held vibrators through the concrete. Do not walk through consolidated concrete.

**D. Form Removal.** Remove forms after the concrete has developed sufficient strength to allow removal without damaging the pavement. Repair pavement damaged during form removal. Remove forms before making second-stage saw cuts.

**502-3.06 Joint Construction.** Provide the Engineer approved Materials Details for longitudinal joint ties and transverse joint supports before placing any joint hardware. Construct joints in accordance with the Standard Sheets and approved Materials Details. Do not stand on joint hardware.

Base final joint layout on construction staging and the actual location of utilities, drainage structures, intersections, tapers, and other irregular areas. Submit a proposed joint layout to the Engineer at least 10 calendar days prior to PCC paving. Obtain the Engineer's joint layout approval before paving.

Make second-stage saw cuts and bevels, clean, and seal joints in accordance with §502-3.12, Sealing Joints.

**A. Transverse Joints.** Transverse joints include contraction, expansion, hinge, and construction joints. Secure joint supports to the permeable base or subbase as depicted in the Materials Details. Maintain joint supports in their proper position and alignment during paving.

Construct transverse joints perpendicular to both the pavement surface and longitudinal joints in the area being paved. Use a 4.8 m typical transverse joint spacing for pavements having standard slab widths of 3.66 m and 4.27 m. For pavements having other slab widths, determine typical maximum and minimum transverse joint spacings in accordance with the following:

- $L_{max}$  = maximum transverse joint spacing (slab length), m =  $W_{min} \times 1.33$   
 $L_{min}$  = minimum transverse joint spacing (slab length), m =  $W_{max} \div 1.33$   
 $W_{max}$  = maximum slab width across the pavement (load carrying slabs only), m  $\leq$  4.8 m  
 $W_{min}$  = minimum slab width across the pavement (load carrying slabs only), m

The range of slab lengths may be extended to 3.0 m - 5.0 m (from  $L_{min}$  m -  $L_{max}$  m above) in accordance with the contract documents to accommodate utilities, drainage structures, and irregular areas.

**1. Transverse Contraction Joints.** All transverse joints are contraction joints unless otherwise shown in the contract documents. Typically, contraction joints are constructed in a straight line across the full width of the PCC pavement and shoulders. Contraction joints may be slightly angled (rather than straight across a pavement) at tied longitudinal joints between lanes placed separately if the placements do not have the same centerline, e.g., where a ramp centerline diverges from parallel to the pavement centerline. Contraction joints may terminate at, or be misaligned at, untied longitudinal joints as discussed in §502-3.06B3, Untied Longitudinal Joints with Keyway.

Store transverse contraction joint support assemblies in inverted stacks at the project site. Handle joint supports such that no twisting or bending occurs during storage and positioning. Supports with bent, twisted, or deformed wires will be rejected.

Before placing concrete, position transverse joint supports such that the:

- Entire longitudinal axis of each dowel is located at the middepth of the pavement slab ( $\pm 6$ mm).
- Longitudinal axes of the dowels are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one dowel end relative to the other is 4 mm.
- Midpoint of the longitudinal axis of each dowel is at the center of the joint ( $\pm 25$  mm).
- Longitudinal axes of the two end dowels are 100 mm – 200 mm from the longitudinal joints.
- Longitudinal axes of the dowels are spaced 100 mm – 300 mm apart.

Mark the location of each contraction joint before placing concrete. In a slipform paving operation, mark the joint support midpoint on the subbase or permeable base immediately adjacent to the pavement. In a fixed form paving operation, mark the joint support midpoint with shims as discussed in §502-3.05B, Paving. Immediately before concrete placement, cut the tie wires (parallel to the dowels) holding the 2 upper transverse support members in position.

Make first-stage saw cuts as soon as the concrete has hardened sufficiently to permit sawing without causing raveling wider than 3 mm. Replace blades if raveling persists. Center first-stage saw cuts within 25 mm of the longitudinal midpoints of the dowels.

Complete first-stage saw cuts before any uncontrolled cracking occurs. Be prepared to make first-stage saw cuts 24 hours a day to prevent uncontrolled cracking. Provide lighting required to make first-stage saw cuts at night at no additional cost to the State.

Sweep or wash first-stage saw cut debris from the pavement before profilographing, before it rains, or before opening the pavement to any traffic, such that debris does not enter the joint.

**2. Transverse Expansion Joints.** Construct transverse expansion joints as part of the utility and drainage structure isolation systems depicted in the Standard Sheets or where indicated in the

contract documents. Handle and position expansion joint supports in accordance with §502-3.06A1, Transverse Contraction Joints.

Construct expansion joints using 10 mm – 15 mm thick premoulded resilient joint filler placed in 1 piece between longitudinal joints. Tightly place and support abutting sections of joint filler such that no concrete infiltrates the joint. Place expansion caps on the dowels as depicted in the Materials Details. Do not tap or hammer the caps onto the dowels.

No saw cuts are required in expansion joint construction. Remove the finishing cap, if supplied, after the concrete has developed sufficient strength to prevent damage.

**3. Transverse Construction Joints.** Construct transverse construction joints wherever there is an interruption of more than 30 minutes in concrete paving operations. Construct these joints as wide as the concrete placement, typically 1 or 2 lanes, but not necessarily the full pavement width. Align construction joints with transverse contraction or construction joints in adjacent lanes.

At unplanned stops, remove plastic concrete to the midpoint of the preceding transverse joint support. Place an Engineer-approved bulkhead over the exposed support assembly such that half of the dowel lengths are embedded within newly placed concrete. Immediately remove all plastic concrete in front of the bulkhead and from the exposed joint support.

At planned stops, use either the bulkhead system described above or transverse joint supports fabricated with hollow plastic cylinders, closed on one or both ends, instead of dowels. Use hollow cylinders with an inner diameter 0 mm – 1 mm greater than the required dowel diameter and an outer diameter 7 mm, maximum, larger than the required dowel diameter. Position cylinders as required in §502-3.06A1, Transverse Contraction Joints, with closed ends on the side of the support opposite to the paving direction.

Pave beyond the joint support containing the hollow cylinders. After the concrete has gained sufficient strength to prevent damage, saw cut the newly placed concrete full depth through the midpoint of the longitudinal axis of each cylinder ( $\pm 25$  mm). Do not saw cut into previously placed PCC. Instead, stop saw cutting at the longitudinal joint between placements and chip out any uncut concrete such that a vertical joint face results.

Remove concrete and the joint assembly ahead of the saw cut. Repair damaged permeable base and/or subbase with coarse aggregate having a CA 1 or CA 2 gradation. Insert dowels into the exposed hollow cylinder to the required alignment in §502-3.06A1, Transverse Contraction Joints, and resume paving.

First-stage saw cuts are not required at construction joints.

**4. Transverse Hinge Joints.** Do not place hinge joints without the Engineer's approval. Construct transverse hinge joints when a slab length exceeds the geometric requirements of §502-3.06, Transverse Joints. (This situation typically occurs near structures that are skewed from perpendicular to the pavement centerline.)

Locate hinge joints such that they are equally spaced between other types of transverse joints. Construct hinge joints in accordance with 502-3.06A1, Transverse Contraction Joints, except the positioning requirements do not apply. Instead, position transverse hinge joint supports such that the:

- Entire longitudinal axis of each deformed bar is located at the middepth of the pavement slab ( $\pm 6$  mm).
- Longitudinal axes of the bars are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one bar end relative to the other is 25 mm.
- Midpoint of the longitudinal axis of each bar is at the center of the joint ( $\pm 25$  mm).

- Longitudinal axes of the two end bars are 100 mm – 250 mm from the longitudinal joints.
- Longitudinal axes of adjacent bars are spaced 100 mm – 450 mm apart.

**B. Longitudinal Joints.** Select tie type, size, spacing, and positioning in accordance with the contract documents. Provide a minimum clearance of 75 mm between the end ties in a slab and any part of the transverse joint support. Keep ties free of materials that inhibit bonding to concrete or anchoring material. Maintain ties in their proper position during paving.

Eliminating a longitudinal joint (and subsequent sawing and sealing) between a shoulder and adjacent lane is optional provided (1) the lane and shoulder are paved simultaneously and (2) the resulting slabs meet the geometric requirements detailed in §502-3.06A, Transverse Joints.

It is highly desirable to align longitudinal joints with the permanent pavement markings. Tied longitudinal joints located in the wheelpaths of the completed pavement will require additional ties.

**1. Longitudinal Joints Between Lanes Paved Simultaneously.** Use one-piece ties fabricated into assemblies capable of securely holding 2 or more ties. Secure the assemblies to the permeable base or subbase prior to paving in accordance with the Materials Details.

Make first-stage saw cuts parallel to the pavement centerline and perpendicular to the pavement surface within 24 hours of concrete placement and after first-stage transverse saw cuts are complete. Replace saw blades if raveling wider than 3 mm occurs. Center first-stage saw cuts within 25 mm of the longitudinal midpoint of the ties.

Sweep or wash first-stage saw cut debris from the pavement before profilographing, before it rains, or before opening the pavement to any traffic, such that debris does not enter the joint.

**2. Tied Longitudinal Joints Between Lanes Paved Separately.** In a slipform operation, construct a butt joint and drill and anchor one-piece ties into the hardened concrete. Do not drill holes until the concrete has developed sufficient strength to withstand drilling without damage. Damage from drilling will be treated in accordance with §502-3.14, Damaged or Defective Concrete.

Use # 19 ties, 700 mm long between travel lanes and 450 mm long between a travel lane and a PCC shoulder. Anchor ties between travel lanes 300 mm into the previously placed concrete, leaving 400 mm projecting from the joint face. Anchor ties between a travel lane and a PCC shoulder 200 mm into the previously placed concrete, leaving 250 mm projecting from the joint face.

Place end ties in a slab 300 mm – 350 mm from the transverse joint. Typically, space ties between the end ties 600 mm apart, maximum. Pavements having 4 or more tied lanes, or 3 lane pavements 300 mm (or more) thick, may require a decreased spacing in accordance with the contract documents.

Drill such that the hole diameters are in accordance with the anchoring material manufacturer's written recommendations. Give those recommendations to the Engineer before drilling any holes. Replace worn bits when necessary to ensure the proper hole diameter is drilled.

Follow the anchoring material manufacturer's written recommendations for cleaning the holes. Give those recommendations to the Engineer. As a minimum, air blast the drilled holes. Insert the air blasting equipment nozzle to the back of the hole to force out all dust and debris.

When using new cartridges of anchoring material, ensure the initial material exiting the nozzle appears uniformly mixed. If it is not uniformly mixed, waste the material until uniformly mixed material extrudes.

Place the anchoring material in the back of the hole using a nozzle or wand of sufficient length. Push the tie into the hole while twisting such that the air pocket within the hole is heard to burst and the anchoring material is evenly distributed around the bar. Use sufficient amounts of anchoring material such that it slightly extrudes out the hole as the bar is inserted.

In a fixed form operation, construct either a butt or a keyed joint. If a butt joint is constructed, drill and anchor longitudinal joint ties as described above. If a keyed joint is constructed, use multiple-piece ties. Apply a corrosion inhibiting coating to the threads of all components before assembly. Bolt the female portion of the tie to the form prior to paving as depicted in the Standard Sheets. Insert and tighten the male ends before paving the adjacent lane. Ensure all threaded connections are tight.

First-stage saw cuts are not required between lanes paved separately.

**3. Untied Longitudinal Joints with Keyway.** Construct untied longitudinal joints with keyways at utilities and/or drainage structures, at intersections, between adjacent lanes having non-parallel center lines (such as ramps), or where indicated in the contract documents. Form as depicted in the Standard Sheets. Transverse joint type, location, and alignment may be changed when a transverse joint intersects an untied longitudinal joint.

Patch honeycombing along the untied longitudinal joint face to achieve a smooth surface prior to applying the bond breaker and placing the adjacent concrete.

First-stage saw cuts are not required.

**C. Utility and Drainage Structure Isolation Joint Systems and Telescoping Manholes.**

Isolate utilities and drainage structures from the pavement using the isolation joint systems or telescoping manhole castings depicted in the Standard Sheets. Remove temporary support bolts from the telescoping manhole casting as soon as the concrete hardens. If telescoping manhole castings are not used, form the required isolation joint system.

Construct transverse portions of the isolation joint systems in accordance with §502-3.06A2, Transverse Expansion Joints, or §502-3.06A3, Transverse Construction Joints, in accordance with the contract documents. Construct other isolation joints in accordance with the contract documents.

**502-3.07 Paving Adjacent To Existing Concrete.** Wherever paving equipment operates on existing PCC pavement that is to remain, install bolt-on track covers or rubber tired, flangeless wheels. Remove all debris on the existing PCC pavement in the equipment track. Immediately remove any concrete that spills onto the existing concrete.

When paving from (or to) a transverse construction joint or intersecting pavement, use hand-held vibrators to thoroughly consolidate any concrete inaccessible to the paving equipment vibrators. Hand finish these areas with the minimum effort required to produce an acceptable surface. Do not dump the grout box head into the pavement concrete when approaching a construction joint.

**502-3.08 Plastic Thickness Determination.** In a slipform paving operation, anchor flat, thin (1 mm – 3 mm), 150 mm x 150 mm rigid steel or plastic plates to the permeable base (or subbase) surface 600 mm from both placement edges at 50 m intervals. Clearly mark the plate locations on the subbase, permeable base, or previously placed concrete immediately adjacent to the placement. Provide the Engineer with a round, rigid, nonaluminum probe, having a 3 mm - 4 mm diameter. The Engineer will determine the plastic concrete thickness by inserting the probe to the plate and measuring the insertion depth. The plate thickness will be added to the insertion depth to determine concrete thickness.

In a slipform paving operation, the minimum measured plastic thickness must be within 10 mm of the thickness required in the contract documents. Areas not meeting minimum thickness will be treated in

accordance with §502-3.14, Damaged or Defective Concrete. If 2 consecutive measurements do not meet minimum thickness, stop paving and reestablish the paving operation to achieve acceptable thickness.

**502-3.09 Finishing.** Mechanically finish the pavement after consolidation and strike off. Use machine mounted finishers such as full-width finishing pans, transverse oscillating screeds, longitudinal floats, pan floats or separate pieces of equipment such as tube floats or Lewis floats.

After mechanical finishing, hand finish the pavement to correct and seal minor imperfections. Provide an ACI certified concrete flatwork finisher to supervise all hand finishing. Provide proof of ACI flatwork certification to the Engineer. Keep hand finishing to a minimum. Do not use excess mortar or discarded concrete to fill low areas. Use work bridges to hand finish concrete inaccessible from the pavement edge. Do not add water to the concrete surface to close imperfections. Stop paving or reformulate the concrete mix if surface imperfections that require additional water to close routinely occur.

**502-3.10 Texturing.** Immediately after finishing and prior to applying the curing compound, texture the concrete surface using one of the following procedures in accordance with the contract documents. Apply longitudinal tining if no texturing method is designated in the contract documents. Additional requirements, such as Mean Texture Depth measured by a sand patch test or a profiler may be included in the contract documents. If the contract has a closed drainage system, provide a 200 mm – 300 mm blank in the texture along the pavement edges to enhance drainage to catch basins.

**A. Longitudinal Tining.** Texture the concrete parallel to the pavement centerline with a set of evenly spaced spring steel tines. Use rectangular tines 3 mm wide, 0.7 mm thick, and approximately 125 mm long at a center-to-center spacing of 19 mm.

Operate the tine head manually or mechanically. In either case, hold the tines as near an angle of 45° to the concrete surface as possible to minimize mortar dragging. Produce tine texture 2 mm – 4 mm deep with minimal dislodging of aggregate. Do not make multiple tine passes in the same area. Keep tines 50 mm – 100 mm from the placement edges. Keep the tines free of hardened concrete.

**B. Artificial Turf Drag.** Use a seamless strip of artificial turf drag appearing on the Department's Approved List entitled "Turf Drag" under "Equipment, Concrete Related." Produce a consistent texture, free of ridges or gouges, parallel to the pavement centerline either by hand or by attaching a weighted strip to the paver, texture\cure machine, or work bridge. Periodically replace or clean the drag to remove hardened concrete paste that compromises texture.

**C. Transverse Tining.** Texture the concrete perpendicular to the pavement centerline with a set of variably spaced spring steel tines. Use rectangular tines 3 mm wide, 0.7 mm thick, and approximately 125 mm long at the following center-to-center spacing in millimeters:

16/25/22/16/32/19/25/25/25/25/19/22/25/22/10/25/25/25/32/38/22/25/22/25.

Operate the tine head manually or mechanically. In either case, hold the tines as near an angle of 45° to the concrete surface as possible to minimize mortar dragging. Produce tine texture 2 mm – 4 mm deep with minimal dislodging of aggregate. Do not make multiple tine passes in the same area. Keep the tines free of hardened concrete. If the tine texture is placed manually, or if the mechanical equipment does not operate from the same referencing system as the paver, provide a 75 mm – 100 mm blank at each transverse joint saw cut location.

**502-3.11 Curing.** Keep the curing operation close to the texturing operation such that concrete is cured immediately after it is textured. The Engineer may stop paving if curing lags. Cure Class C concrete placed between June 1 and September 15 for 4 days, minimum. Cure Class C concrete placed between September 16 and May 31 for 6 days, minimum. Cure HES concrete in accordance with Materials Bureau requirements based on the Contractor-submitted mix design and the trial batch evaluation.

**A. White Pigmented Membrane Curing Compound.** Typically, cure concrete with white pigmented membrane curing compound. Mix the curing compound before each use and continuously agitate during use. Thoroughly and uniformly coat all exposed surfaces (including slipformed edges and formed edges immediately after form removal) at a minimum rate of 3.5 m<sup>2</sup>/L. Check the application rate after every paving day, including exposed vertical slab faces in the calculations. Apply the curing compound in 2 opposite direction passes with no longer than 15 minutes between passes.

Immediately reapply curing compound to any damaged coating areas during the curing period. During curing equipment breakdown, cure the pavement in accordance with §502-3.11B, Curing Covers. Do not apply curing compound in the rain. If rain damages the curing compound before it sets, reapply curing compound after the pavement surface dries.

**B. Curing Covers.** Use of curing covers is subject to the approval of the Engineer. Use quilted covers, plastic coated fiber blankets, or polyethylene curing covers. Do not use covers with tears or holes. Cover all exposed surfaces and extend the covers a minimum of 300 mm beyond the pavement edges or beyond the forms, when used. Overlap successive covers 300 mm, minimum. Secure the covers to keep them in contact with the entire surface and maintain the overlap. Wet the entire surface of quilted covers and maintain them in a wetted condition throughout the curing period.

**C. Cold Weather Curing.** Supply form insulating materials for winter concreting when the air temperature is expected to fall below 4°C at any time during the curing period. Use material capable of maintaining a surface temperature of 13°C and being easily removed and replaced to accommodate first-stage saw cuts. Apply the insulating material to prevent newly placed concrete from being exposed to air temperatures below 2°C for the curing period. Secure the insulation tight to the concrete surface to prevent air intrusion beneath the insulation. Extend the insulation 300 mm beyond the newly placed concrete. Insulate the pavement vertical edge and/or forms as well.

Place recording surface thermometers between the pavement surface and insulating material 300 mm from one of the placement edges wherever insulation is used. Use 4 equally spaced thermometers for each day's paving. Do not subject the concrete to a temperature drop in excess of 10°C during the first 24 hours after removing the insulation.

**502-3.12 Sealing Joints.** Seal joints as depicted in the Standard Sheets. Refer to Table 502-3, Joint Sealing Alternatives.

First-stage sawcuts may be temporarily left unfilled if a placement is only subjected to occasional construction traffic, such as pickup trucks or cars. In this case, sweep the pavement to ensure debris does not enter the joints.

Temporarily fill unsealed first-stage cuts with jute or backer rod if a placement is:

- Subjected to consistent construction traffic.
- Used as a haul road for subsequent concrete placements.
- Temporarily opened to general traffic while final sealing has been delayed for convenience, such as to maximize sealing production.

Before cleaning, remove any temporary fillers and repair damaged joints in accordance with §502-3.14, Defective or Damaged Concrete, including chipped joints resulting from debris accumulation in an unfilled or unsealed joint. Do not reuse backer rod used as temporary fillers in the final joint sealing.

**A. Sealing Transverse Contraction Joints – Highway Joint Sealant.** Widen joints to 6 mm – 9 mm for a depth of 25 mm if the first-stage saw cuts are less than 6 mm wide to allow full-depth sealing. Immediately wash the widening cut slurry from the pavement such that it does not reenter the joint. Do not seal transverse construction joints or longitudinal joints when highway joint sealants are specified for transverse contraction joints.

Joint cleaning and sealing may be delayed for convenience. Clean the joints by abrasive blasting immediately before sealing. Keep the nozzle within 50 mm of the joint surfaces.

The Engineer may allow pressure washing in lieu of abrasive blast cleaning if it is not allowed in the contract. When pressure washing, use (1) a 6.0 MPa minimum pressure and (2) a maximum pressure such that no damage occurs to the concrete. Manually dislodge debris remaining in the joint after cleaning, and reclean the joint. Immediately after pressure washing, air blast the joint to remove any debris from the cut and dry the exposed faces.

Do not allow any traffic on the pavement between cleaning and sealing. Reclean the joint if it rains between cleaning and sealing or if any traffic is on the placement between cleaning and sealing.

Provide the Engineer a copy of the sealant Manufacturer's written recommendations for heating and application at least 1 work day before sealing. Follow those recommendations. Unless stated otherwise, the recommended pouring temperature is 5°C below the manufacturer's designated safe heating temperature, with an allowable variation of ± 5°C.

Prior to sealing, discharge sealant from the applicator wand into a vessel and measure the sealant temperature. The temperature must be equal to or above the Manufacturer's recommended minimum pouring temperature and equal to or below the Manufacturer's recommended safe heating temperature.

Do not use sealant heated above the safe heating temperature. Sealant may be reheated or heated in excess of 6 hours if allowed by the Manufacturer's heating and application recommendations. In these cases, recharge the melter with fresh sealant amounting to at least 20% of the sealant volume remaining in the melter.

Seal joints immediately after cleaning. Seal the joint from the bottom of the cut to within 5 mm – 10 mm of the pavement surface. Seal when the:

- Air and surface temperatures are 5°C or warmer.
- Air temperature is above the dew point.
- Pavement surface and all joint surfaces are dry.

Open to traffic after the sealant has cured to prevent tracking. Do not blot with fine aggregate.

**B. Sealing Joints - Silicone Sealant.** Make second-stage saw cuts and/or bevels in accordance with the Standard Sheets and (1) no sooner than 72 hours after concrete placement and (2) after the curing period has ended if curing covers are used. Wash the resulting slurry from the pavement and joint immediately after making second-stage saw cuts and/or bevels.

Second-stage saw cuts may be delayed for convenience, but do not leave second-stage saw cuts unsealed or unfilled while open to any traffic. Temporarily fill second-stage saw cuts with jute or backer rod if (1) they are exposed to any traffic before cleaning and sealing or (2) weather conditions are not favorable for timely (within 2 calendar days) cleaning and sealing, whether or not they are exposed to any traffic. Do not reuse backer rod used as temporary filler in the final joint sealing.

Install the sealant in accordance with the Manufacturer's written instructions. Give those instructions to the Engineer before any second-stage saw cutting begins. Consult the Manufacturer for primer requirements associated with the coarse aggregate used in the concrete.

Abrasive blast both vertical joint faces immediately before sealing. Tilt the nozzle to abrasive blast one vertical face at a time at each joint until uniformly abraded surfaces result. Air blast after abrasive blasting to remove all abrasives. Reclean the joint if it rains between cleaning and sealing. Do not allow any traffic on the pavement between cleaning and sealing. Immediately after blasting, install backer rod to the required depth without ripping, tearing, or puncturing the rod. Roll the insertion wheel over the backer rod twice, once in each direction.

Seal when the:

- Air and surface temperatures are 5°C or warmer.
- Air temperature is above the dew point.
- Pavement and all joint surfaces are dry.

Where possible, first widen and seal the longitudinal joints (if required), then widen and seal the transverse joints such that the entire transverse joint contains a continuous sealant bead. If this is not possible, install the silicone in full placement widths.

Traffic may traverse silicone sealed joints after the sealant has skinned over, provided traffic opening and sealer manufacturer requirements have been met.

**C. Sealing Joints - Preformed Joint Sealers.** Make second-stage saw cuts and/or bevels in accordance with the Standard Sheets and (1) no sooner than 72 hours after concrete placement and (2) after the curing period has ended if curing covers are used. Extend the second-stage saw cut vertically down the free concrete edges. Wash the resulting slurry from the pavement and joint immediately after making second-stage saw cuts and/or bevels.

Second-stage saw cuts may be delayed for convenience, but do not leave second-stage saw cuts unsealed or unfilled while open to any traffic. Temporarily fill second-stage saw cuts with jute or backer rod if (1) they are exposed to any traffic before cleaning and sealing or (2) weather conditions are not favorable for timely (within 2 calendar days) cleaning and sealing, whether or not they are exposed to any traffic.

Clean the joints by pressure washing before sealing. Use (1) a 6.0 MPa minimum pressure and (2) a maximum pressure such that no damage occurs to the concrete. Manually dislodge debris remaining in the joint after cleaning, and reclean the joint. Within 24 hours of pressure washing, air blast the joint to remove any debris from the cut and dry the exposed faces. Reclean the joint if it rains between cleaning and sealing. Do not allow any traffic on the pavement between cleaning and sealing.

Install the sealant in accordance with the Manufacturer's written instructions. Give those instructions to the Engineer before any second-stage saw cutting begins. Lubricate the concrete, the sealer, or both before installation such that the lubricant fully covers the sealer/concrete interface, but not the top of the sealer.

Install one piece of transverse joint sealer in a compressed condition across the full pavement width, including concrete shoulders, and down the vertical saw cut at the free edge. Cut the longitudinal sealer where it crosses a transverse joint. Do not splice the longitudinal sealer between transverse joints. Seal the intersection between longitudinal and transverse sealers with lubricant.

Install the sealer such that it is not stretched more than 5% , nor compressed more than 2%, of the minimum theoretical length. Check the installation for stretch and compression by installing sealers in 5 transverse joints and removing the sealer immediately after installation and checking the length. An alternate method for checking stretch and compression, where applicable, may be performed by premarking or precutting the sealer to length prior to installation. If the measurement

of any of these 5 sealers exhibits stretching in excess of 5% or compression in excess of 2%, modify the installation method to meet the requirements or discontinue installation.

Once sealing operations begin, remove 1 joint per 100 in the presence of the Engineer to check stretch and compression. If the sealer is found to be stretched in excess of 5% or compressed in excess of 2%, remove the sealer material from successive joints in both directions until sealers are found that meet the stretch and compression requirements. Replace all joints sealers found with excess stretch or compression. Replace joint sealers removed and found to meet the stretch and compression requirements.

<b>Joint Type</b>	<b>Sealing Alternative</b>	<b>First-Stage Saw Cut Required</b>	<b>Second-Stage Saw Cut and Bevel Required</b>
Transverse Contraction	Silicone or Preformed	Yes	Both
	Highway Joint Sealant	Yes	Neither
Transverse Expansion and Isolation	Silicone or Preformed	No	Bevel Only
Transverse Construction	Silicone or Preformed	No	Both
	Do Nothing <sup>1</sup>	No	Neither
Longitudinal - Between Lanes Placed Simultaneously	Silicone or Preformed	Yes	Second-Stage Only
	Do Nothing <sup>1</sup>	Yes	Neither
Longitudinal - Between Lanes Placed Separately and Untied Joints With Keyway	Silicone or Preformed	No	Second-Stage Only
	Do Nothing <sup>1</sup>	No	Neither

NOTE:

1. Do nothing if highway joint sealants are specified for transverse contraction joints.

**502-3.13 Pavement Protection.** Protect the pavement and appurtenances from traffic and construction operations. Protect the work and provide for traffic as indicated in the contract documents.

**502-3.14 Damaged or Defective Concrete.** Repair or replace all damaged or defective concrete which occurs prior to final acceptance. Perform these repairs as described in the contract documents at no cost to the State. Damage and defects include, but are not limited to, cracking, spalling, honeycombing, or imperfections caused by inadequate pavement protection, traffic, and/or construction practices. Slipformed concrete with inadequate plastic thickness as described in §502-3.08, Plastic Thickness Determination, will be rejected in 50 m segment lengths.

**502-3.15 Hardened Surface Test (Nonprofilographed Concrete).** After the concrete has hardened sufficiently, test the entire longitudinal center of each travel lane, including ramps, with a 3 m, minimum, long straight edge laid longitudinally. The Engineer will mark high and low deviations in the pavement surface exceeding 3 mm in 3 m. Diamond grind these deviations such that they do not exceed 3 mm in 3 m when retested with the straight edge.

**502-3.16 Profilograph.** This section applies to profilographed concrete (and nonprofilographed concrete when a full-width finishing pan or triple transverse screed paving operation is not employed).

The Engineer will divide each travel lane into reporting segments that are 160 m long. The Engineer will group segments shorter than 160 m with previous or subsequent segments. Provide survey stationing and develop a reference system that allows the Engineer to readily associate profilograph data to the corresponding reporting segment.

Develop a profile trace for each wheelpath in each reporting segment in accordance with Materials Method 24, PCC Pavement Profilograph Operations. Determine an initial profile index (PI) for each reporting segment by averaging the PIs of the wheelpaths. Provide the traces and initial PIs to the Engineer. The Engineer will identify bumps exceeding 10 mm in 7.6 m on each profile trace. Locate and diamond grind these bumps, if any, to 10 mm or less in 7.6 m. If no grinding is required for a given reporting segment, the initial PI may be used to determine the payable Quality Units of Smoothness Quality Adjustment per reporting segment.

Production diamond grinding equipment can be used to increase the amount of Quality Units payable as discussed in §502-3.17, Diamond Grinding. Whether diamond grinding was required through profile trace analysis, or performed as a Contractor option, reprofilograph each reporting segment that was diamond ground and determine a final PI. Give the Engineer the final profile traces and final PI determined by using both the 5 mm and zero blanking bands.

**502-3.17 Diamond Grinding.** Diamond grind the pavement longitudinally, beginning and ending at lines normal to the pavement centerline, and in full travel lane width increments. Provide surface drainage by maintaining the proper cross slope on the finished surface and by blending adjacent passes.

Continuously vacuum the slurry from the pavement when production grinding. If roadside slurry discharge is not allowed by the contract documents, transfer the slurry into equipment capable of transporting it from the contract site without spills. Dispose of slurry in conformance with all Federal, State, and local regulations.

In any case, do not allow slurry to enter:

- Occupied travel lanes.
- Drainage structures.
- Wetlands, streams, estuaries, or sensitive environmental resources.
- Areas where it will become a public nuisance.

Use of bump grinding equipment is restricted to grinding bumps that exceed 10 mm in 7.6 m in profilographed concrete and bump grinding non-profilographed concrete. Production grinding equipment can be used to grind bumps or increase the amount of Quality Units payable subject to the following:

- For pavements textured with longitudinal tining or artificial turf drag, any amount of a reporting segment surface area may be diamond ground to increase the amount of Quality Units payable.
- For transverse tined pavements, Quality Units are payable if less than 20% or more than 95% of the reporting segment surface area is ground. If more than 20% of the reporting segment area is ground for any reason, diamond grind 95%, minimum, of the entire reporting segment.

### **502-3.18 Opening to Traffic**

**A. Construction Traffic.** Class C concrete may be opened to construction traffic and paving equipment 7 days after placement. With the Engineer's approval, this time frame may be shortened to 3 days if cylinders achieve a compressive strength of 17 MPa in accordance with §502-3.18C, Project Strength Determination. Any pavement damaged from opening to construction traffic in a reduced time frame will be treated in accordance with §502-3.14, Damaged or Defective Concrete.

**B. General Traffic.** Class C concrete placed between June 1 and September 15 may be opened to general traffic 10 days after placement. Class C concrete placed outside this interval may be opened to general traffic 15 days after placement. With the Engineer's approval, these time frames may be shortened to 4 days if cylinders achieve a compressive strength of 21 MPa in accordance with §502-3.18C, Project Strength Determination, and the joints are addressed in accordance with §502-3.12, Sealing Joints.

If Project Strength Determination testing for construction traffic opening indicates the concrete has achieved a compressive strength in excess of 21 MPa, the concrete may be opened to general traffic after 4 days. Any pavement damaged from opening to general traffic in a reduced time frame will be treated in accordance with §502-3.14, Damaged or Defective Concrete.

**C. Project Strength Determination.** Provide an ACI Certified Concrete Field Testing Technician, Grade I, or higher, to cast all cylinders. Unless otherwise noted in the contract documents, use an agency accredited by the AASHTO Accreditation Program (AAP) in the field of construction materials testing of portland cement concrete to perform compressive strength testing. Cast and test in the presence of the Engineer, or the Engineer's representative. Provide acceptable proof of ACI Certification and AASHTO Accreditation to the Engineer before placing any concrete. The Engineer, or the Engineer's representative, will complete the Concrete Cylinder Report as cylinders are cast and tested.

Cast a minimum of 3 cylinder pairs (6 total) from each 300 m of paving length, or fraction thereof, in accordance with Materials Method 9.2, Field Inspection of Portland Cement Concrete. Cast each pair from different delivery trucks. Develop an Engineer-approved marking system that allows a cylinder to be readily associated with the corresponding placement location and placement time. Mark the cylinders and place them adjacent to the pavement under similar curing conditions. Determine the concrete compressive strength at the desired time in accordance with ASTM C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens. The pavement may be opened to construction (or general) traffic if all the following apply:

- Average compressive strength of all cylinder pairs exceed 17 MPa (or 21 MPa).
- Average compressive strength of each cylinder pair exceeds 14 MPa (or 17 MPa).
- Appropriate time frame has elapsed for the entire area to be opened.

If these conditions are not met, test 3 additional cylinder pairs at a later time, provided the appropriate numbers of additional cylinders were cast. If the above conditions are not met after additional testing, or, if the required number of additional cylinders were not cast, open the pavement in accordance with the nonreduced time frames of §502-3.18A, Construction Traffic, and §502-3.18B, General Traffic.

**D. HES Concrete.** HES concrete may be opened to construction traffic when it has achieved a compressive strength of 17MPa and to general traffic when it has achieved compressive strength of 21 MPa, in accordance with §502-3.18C, Project Strength Determination, and the joints are addressed in accordance with §502-3.12, Sealing Joints.

**502-4 METHOD OF MEASUREMENT.** The Engineer will measure the following quantities for items incorporated into the finished pavement:

**502-4.01 Portland Cement Treated Permeable Base.** The work will be measured for payment as the number of cubic meters of portland cement treated permeable base satisfactorily placed based on the payment lines shown in the contract documents. No deductions will be made for catch basins, manholes, or other similar pavement obstructions.

**502-4.02 PCC Pavement, Unreinforced.** The work will be measured for payment as the number of cubic meters of unreinforced PCC pavement satisfactorily placed based on the payment lines shown in the contract documents. Deductions in 50 m segment lengths will be made for areas that do not meet minimum plastic thickness requirements. Deductions (and separate payment) will be made for catch basins, manholes, or other similar pavement obstructions requiring either mesh reinforced or heavily reinforced placements.

**502-4.03 PCC Pavement, Mesh or Heavily Reinforced.** The work will be measured for payment as the number of cubic meters of reinforced concrete satisfactorily placed. No deductions will be made for drainage and utility structures or other similar pavement obstructions being isolated from the surrounding pavement.

**502-4.04 Smoothness Quality Adjustment (Profilographed Items Only).** The work will be measured for payment as the number of Quality Units of Smoothness Quality Adjustment, if any, payable for each reporting segment determined by the following:

$$\text{Quality Units (Per Segment)} = (\text{SAF} - 1.00) \times \text{PCC Cubic Meters (Per Segment)}$$

The Smoothness Adjustment Factor (SAF) from Table 502-4, Smoothness Adjustment Factors, is based on the final PI obtained for each reporting segment using a 5 mm blanking band. No Quality Units are computed for pavements specified as nonprofilographed.

<b>TABLE 502-4 SMOOTHNESS ADJUSTMENT FACTORS</b>		
<b>Final Profile Index (mm/km.)</b>	<b>Level 1 SAF</b>	<b>Level 2 SAF</b>
0.0 - 16.0	1.05	1.05
16.1 - 32.0	1.04	1.04
32.1 - 48.0	1.03	1.03
48.1 - 64.0	1.02	1.02
64.1 - 79.9	1.01	1.01
80	1.00	1.00
80.0 +	Grind	1.00
190.0 +	Not Applicable	Grind

**502-4.05 Constructing Transverse Joints.** The work will be measured for payment as the number of meters of transverse joints satisfactorily constructed.

**502-4.06 Constructing Longitudinal Joints.** The work will be measured for payment as the number of meters of longitudinal joints satisfactorily constructed.

**502-4.07 Sealing Transverse Joints.** The work will be measured for payment as the number of meters of transverse joints satisfactorily sealed, excluding preformed sealers turned down at the pavement edges.

**502-4.08 Sealing Longitudinal Joints.** The work will be measured for payment as the number of meters of longitudinal joints satisfactorily sealed.

## **502-5 BASIS OF PAYMENT**

**502-5.01 Portland Cement Treated Permeable Base.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for Portland Cement Treated Permeable Base.

**502-5.02 PCC Pavement, Unreinforced, Nonprofilographed.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for PCC Pavement, Unreinforced, Nonprofilographed. No payment will be made for areas that do not meet minimum plastic thickness requirements. No additional payment will be made for Contractor-requested HES concrete mixes.

Also include the cost of all labor, material, and equipment necessary to profilograph and diamond grind the pavement to meet the Level 2 smoothness requirements of Table 502-4, Smoothness Adjustment Factors, if paving equipment other than a paver equipped with a full-width finishing pan or triple transverse screeds is used. In this case, no payment will be made for SAF Quality Units.

PCC Pavement, Unreinforced, Nonprofilographed will be eligible for progress payments in accordance with the following:

- 80% upon satisfactory completion of all work up to, and including, first-stage saw cutting.
- An additional 10% upon satisfactory completion of diamond grinding, if any.
- The remaining 10% upon satisfactory completion of the work.

**502-5.03 PCC Pavement, Unreinforced, Profilographed.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for PCC Pavement, Unreinforced, Profilographed. No payment will be made for areas that do not meet minimum plastic thickness requirements. No additional payment will be made for Contractor-requested HES concrete mixes.

PCC Pavement, Unreinforced, Profilographed will be eligible for progress payments in accordance with the following:

- 80% upon satisfactory completion of all work up to, and including, first-stage saw cutting.
- An additional 10% upon satisfactory completion of diamond grinding, if any.
- The remaining 10% upon satisfactory completion of the work.

**502-5.04 Smoothness Quality Adjustment.** Quality Units of Smoothness Quality Adjustment are a fixed price in the bid documents and cannot be changed by the Contractor.

**502-5.05 PCC Pavement, Mesh or Heavily Reinforced.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for PCC Pavement, Mesh or Heavily Reinforced. No additional payment will be made for Contractor-requested HES concrete mixes.

**502-5.06 Constructing Transverse Joints.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for Constructing Transverse Joints.

**502-5.07 Constructing Longitudinal Joints.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for Constructing Longitudinal Joints. Placing the inside shoulder and inside lane simultaneously, at the Contractor's option, will not generate a Significant Change in the Character of Work. No additional payment will be provided for the additional number of longitudinal joint ties associated with:

- Constructing butt joints between lanes placed separately in a slipform paving operation.
- Constructing longitudinal joints in wheelpaths.

**502-5.08 Sealing Transverse Joints.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for Sealing Transverse Joints.

**502-5.09 Sealing Longitudinal Joints.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for Sealing Longitudinal Joints. Placing the inside shoulder and inside lane simultaneously, at the Contractor's option, will not generate a Significant Change in the Character of Work.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
502.0001 M	Portland Cement Treated Permeable Base	Cubic Meter
502.RPCF M	PCC Pavement	Cubic Meter

<u>R – Pavement &amp; Reinforcement</u>	<u>P – Profilgaphing</u>	<u>C – Concrete Class</u>	<u>F – Friction Type</u>
0 – Unreinforced	0 – Nonprofilographed	1 – Class C	1 – Type 1
1 – Mesh Reinforced	1 – Level 1	3 – HES	2 – Type 2
2 – Heavily Reinforced	2 – Level 2		3 – Type 3
			9 – Type 9

502.9010 M	Smoothness Quality Adjustment	Quality Unit
502.91 M	Constructing Transverse Joints	Meter
502.9110 M	Constructing Longitudinal Joints	Meter
502.92 M	Sealing Transverse Joints – Silicone Joint Sealant	Meter
502.9201 M	Sealing Transverse Joints – Preformed Elastic Joint Sealer	Meter
502.9210 M	Sealing Transverse Contraction Joints – Highway Joint Sealant	Meter
502.93 M	Sealing Longitudinal Joints – Silicone Joint Sealant	Meter
502.9301 M	Sealing Longitudinal Joints – Preformed Elastic Joint Sealer	Meter”

Make the following changes to the Standard Specifications of January 2, 2002.

**Pages 5-38 to 5-39**

**Delete** Section 503, Portland Cement Concrete Foundation for Pavement, in its entirety and **replace** it with the following.

**“SECTION 503 - PORTLAND CEMENT CONCRETE FOUNDATION  
FOR PAVEMENT**

**503-1 DESCRIPTION.** Construct a portland cement concrete (PCC) foundation for pavements and shoulders, if required, as detailed in the contract documents.

**503-2 MATERIALS.**

Portland Cement Concrete	501
Anchoring Materials - Chemically Curing	701-07
Premoulded Resilient Joint Filler	705-07
Longitudinal Joint Ties	705-14
Transverse Joint Supports	705-15
Epoxy Coated Bar Reinforcement, Grade 420	709-04
Quilted Covers (for curing)	711-02
Plastic Coated Fiber Blankets (for curing)	711-03
Polyethylene Curing Covers (white opaque)	711-04
Form Insulating Materials for Winter Concreting	711-07
Water	712-01

In addition to meeting the requirements of §701-07, Anchoring Materials - Chemically Curing, the material used to anchor longitudinal joint ties, dowels, or other miscellaneous items into hardened concrete must be a pourable, two-component, 100% solids structural epoxy dispensed:

- From side-by-side cartridges by manual or pneumatically powered injection guns.
- Through a static mixing nozzle that homogeneously mixes the material without any hand mixing.

Apply the requirements of the following in accordance with the contract documents:

- §502-2.01, Concrete.
- §502-2.02, High-Early-Strength (HES) Concrete.
- §502-2.03, Portland Cement Treated Permeable Base.
- §502-2.04, Equipment.
- §502-2.04A, Slipform Paving.
- §502-2.04B, Fixed Form Paving.
- §502-2.04C, Vibrators.
- §502-2.04D, Permeable Base Paving Equipment.
- §502-2.04E, Saw Cutting Equipment.
- §502-2.04I, Drills.
- §502-2.04L, Air Blasting Equipment.

**503-3 CONSTRUCTION REQUIREMENTS.** Apply the requirements of §502-3, Portland Cement Concrete Pavement, except as modified herein.

**503-3.01 Placement of Reinforcement.** Place bar reinforcement around utilities, drainage structures, and other projections into the pavement as depicted in the Standard Sheets for PCC Pavements. Use telescoping manholes when required by the contract documents in accordance with §502-3.06C, Utility and Drainage Structure Isolation Joint Systems and Telescoping Manholes.

**503-3.02 Joints.** Transverse joint supports are not required for contraction joints. Saw cut skewed contraction joints at a "6 on 1" skew across the pavement (approximately 10° from perpendicular to the centerline) before uncontrolled cracking occurs. Saw cut in accordance with the first-stage saw cut details in the Standard Sheets.

Use a maximum joint spacing of 6 m and a minimum spacing that satisfies the geometric requirements of §502-3.06A, Transverse Joints. Center utilities and drainage structures between saw cuts. Skewed joints may be cut at the same angle across the pavement or chevron-shaped with the vertex at a longitudinal joint between separate placements. Maintain the same technique once selected.

Construct transverse construction joints perpendicular to the centerline in accordance with §502-3.06A3, Transverse Construction Joints.

Construct longitudinal joints in accordance with §502-3.06B, Longitudinal Joints.

**503-3.03 Finishing.** Hand finish the pavement to correct surface irregularities.

**503-3.04 Testing the Surface.** Immediately after placement, test the entire longitudinal center of each travel lane with a 3 m, minimum, long straight edge laid longitudinally. Immediately correct any surface irregularity exceeding 10 mm in 3 m.

**503-3.05 Texturing.** Immediately after testing the surface, apply an aggressive transverse broom finish.

**503-3.06 Curing.** Cure in accordance with §502-3.11, except the impervious membrane method, i.e., curing compound, is not be permitted.

**503-3.07 Surface Test.** No surface test on the hardened concrete will be required.

**503-3.08 Sealing Joints.** Typically, no joint sealing is required in the PCC foundation course. Seal skewed contraction joints in accordance with §502-3.12A, Sealing Transverse Contraction Joints – Highway Joint Sealant, if a construction delay occurs that prevents the placement of the final pavement course until the subsequent construction season.

#### **503-4 METHOD OF MEASUREMENT.**

**503-4.01 Portland Cement Concrete Foundation for Pavement.** The work will be measured for payment as the number of cubic meters of Portland Cement Concrete Foundation for Pavement based on the payment lines shown in the contract documents. No deductions will be made for catch basins, manholes, or other similar pavement obstructions.

**503-4.02 Constructing Longitudinal Joints.** The work will be measured for payment as the number of meters of longitudinal joints satisfactorily constructed.

**503-5 BASIS OF PAYMENT.**

**503-5.01 Portland Cement Concrete Foundation for Pavement.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for Portland Cement Concrete Foundation for Pavement. No payment will be made for areas that do not meet minimum plastic thickness requirements as described in §502-3.08, Plastic Thickness Determination. No additional payment will be made for Contractor-requested HES concrete mixes.

**503-5.02 Constructing Longitudinal Joints.** Include the cost of all labor, material, and equipment necessary to satisfactorily perform the work in the unit price bid for Constructing Longitudinal Joints.

*Payment will be made under:*

<b>Item No.</b>	<b>Item</b>	<b>Pay Unit</b>
503.1010 M	PCC Foundation for Pavement, Class C	Cubic Meter
503.1011 M	PCC Foundation for Pavement, Class F	Cubic Meter
503.1012 M	PCC Foundation for Pavement, HES Concrete	Cubic Meter
503.9110 M	Constructing Longitudinal Joints in Foundation Pavement	Meter"

Make the following changes to the Standard Specifications of January 2, 2002.

**Page 6-48**

line 20, under §608-2, **delete** "Precast Concrete Pavers" and **replace** it with "Precast Concrete Driveway and Sidewalk Pavers."

**Page 7-39**

Line 3, under §704-08 SCOPE **delete** the words "Grouted Stone Block Paving" and **replace** them with "Grouted Stone Block Paved Sidewalks and Driveways."

**Page 7-39**

Line 21, Under §704-09 SCOPE **delete** the words "Grouted Stone Block Paving" and **replace** them with "Grouted Stone Block Paved Sidewalks and Driveways."

**Page 7-44**

Line 17, under §704-13 **delete** the title "Precast Concrete Pavers" and **replace** it with "PRECAST CONCRETE DRIVEWAY AND SIDEWALK PAVERS."

Lines 19, under §704-13 **delete** the words "precast concrete pavers" and **replace** them with "precast concrete driveway and sidewalk pavers."

Lines 20, under §704-13 **delete** the words "precast concrete pavers" and **replace** them with "precast concrete driveway and sidewalk pavers."

Lines 34, under §704-13 **delete** the words "precast concrete pavers" and **replace** them with "precast concrete driveway and sidewalk pavers."

Lines 37, under §704-13 **delete** the words "precast concrete pavers" and **replace** them with "precast concrete driveway and sidewalk pavers."

Lines 44, under §704-13 **delete** the words "precast concrete pavers" and **replace** them with "precast concrete driveway and sidewalk pavers."

**Page 7-45**

Line 41, **Add** the following three new subsections after §704-14.

**"704-23 PRECAST CONCRETE STREET PAVERS**

**SCOPE.** This specification covers the materials details, quality requirements, and method for approval for precast concrete pavers for use in street paving.

**MATERIALS REQUIREMENTS.**

Cement	701-01
Aggregate - Gradation	703-03, 703-04, or 703-07
Aggregate - Friction	501-2.02 B. 2. a.
Water	712-01

No admixtures are required. Coloring agents, when required shall be formulated such that the pavers are colorfast, durable, and resistant to alkali. Other materials may be used in the manufacture as approved by the Director, Materials Bureau.

The shapes, sizes, and colors shall be as specified in the contract documents.

**Pozzolans.** The manufacturer may substitute fly ash meeting the requirements of §711-10 up to a maximum of 15 percent of the minimum portland cement by weight.

**SAMPLING AND TESTING.** Samples of precast concrete street pavers will be obtained by the Materials Bureau for testing and consideration of approval. The manufacturing plant, equipment, and facilities shall meet the approval of the Director, Materials Bureau.

Precast concrete street pavers shall meet the following requirements:

<b>Property</b>	<b>Requirement</b>
Compressive Strength, Min., 28 days	55 MPa Min.
24-hour Absorption,	5.0% Maximum
Freeze-thaw Loss (25 cycles, one per day, 10% NaCl solution)	1.0% Maximum

Satisfactory compliance with all requirements of this specification will result in the name of the manufacturer being placed on the Approved List for Precast Concrete Street Pavers.

**BASIS OF ACCEPTANCE.** Precast concrete street pavers will be accepted at the manufacturing facility in accordance with procedural directives of the Materials Bureau.”

Make the following changes to the Standard Specifications of January 2, 2002.

**Page 7-52**

**Delete** Item 705-14 Longitudinal Joint Ties in its entirety and **replace** it with the following.

**“705-14 LONGITUDINAL JOINT TIES**

**SCOPE.** This specification details the requirements for longitudinal joint ties (LJTs) and their support assemblies used at longitudinal joints in portland cement concrete (PCC) pavement.

**GENERAL.** LJTs are either one-piece deformed bar reinforcement or multiple-piece systems consisting of deformed bar reinforcement with 1 or 2 threaded ends and a coupler. For longitudinal joints between lanes placed simultaneously, one-piece LJTs must be supported by an assembly that secures them in position when the assembly is affixed to the underlying pavement layer. For longitudinal joints between lanes placed separately, the LJTs are either:

- Loose, one-piece, deformed bars drilled and anchored into the vertical placement edge.
- Loose, multiple-piece systems.

In the latter case, the first piece is bolted to the paving forms in the initial concrete placement and the second piece threaded into the first piece after form removal from the initial placement. Refer to Section 502, PCC Pavement, to identify which method is used.

All LJTs not referenced on the Department’s Approved List entitled “Longitudinal Joint Ties (705-14),” under “Joint Materials, Pavement,” will be subject to approval testing before their use is allowed on Department contracts. Submit approval applications to the Director, Materials Bureau, at least 120 days before their intended use. Approved LJTs and their support assemblies will be placed on the Approved List and referenced by the drawing number and approval date. Any change to a previously approved LJT requires approval by the Director, Materials Bureau, before its use.

In case of conflict between the requirements of this specification and specifications referenced herein, the requirements of this specification or the instructions of the Director, Materials Bureau, will apply.

The Department may perform supplementary sampling and testing of the LJTs that arrive at Department contracts.

**MATERIAL REQUIREMENTS**

**A. Deformed Bar Reinforcement.** Obtain deformed bar reinforcement from a manufacturer appearing on the Department’s Approved List entitled “Reinforcing Bars (709-01),” under “Reinforcing, Steel.” Use number 19 deformed bars made of Grade 420 steel. Materials other than steel may be proposed, but their use is subject to the approval of the Director, Materials Bureau.

Use one-piece LJTs having lengths as required by Section 502, PCC Pavement, and the associated 502 Standard Sheets for PCC Pavement, i.e.:

- 900 mm between travel lanes placed simultaneously (in support assemblies).
- 700 mm between travel lanes placed separately (drill and anchor method).
- 500 mm between a travel lane and PCC shoulder placed simultaneously (in support assemblies).
- 450 mm between a travel lane and PCC shoulder placed separately (drill and anchor method).

Use multiple-piece LJT's having lengths of 900 mm between travel lanes placed separately and 500 mm between a travel lane and a PCC shoulder placed separately. The length of a multiple-piece LJT includes only the deformed bar segment lengths, not the thread lengths nor the coupling length. When assembled, the coupler must cover all threads in the threaded ends.

**B. Coatings.** All LJT components must be epoxy-coated steel except for threaded connections. Coatings other than epoxy (and their applicators) may be proposed, but their use is subject to the approval of the Director, Materials Bureau. Use an epoxy coating appearing on one of the following Approved Lists under, "Reinforcing, Epoxy and Coating:"

- Epoxy Coatings for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).

Apply the epoxy coating in accordance with "Coating Application" in §709-04, Epoxy Coated Bar Reinforcement, by an epoxy coating applicator appearing on one of the following Approved Lists under "Reinforcing, Epoxy and Coating:"

- Applicators for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).

Coatings must be continuous over the bar length, including couplers for multiple-piece ties, and 0.20 mm – 0.30 mm thick. Coatings must be within 6 mm of threaded ends in multiple-piece ties. The cross-sectional ends of the bars may be uncoated.

Damaged coatings may be repaired at the epoxy coating applicator's facility or at the fabricator's facility in accordance with "Repair of Coated Bars" in §709-04, Epoxy Coated Bar Reinforcement.

Field repair of damaged coating is allowed, provided the damage is less than 25 mm long in any direction and more than 100 mm from the center of the bar or the threaded ends. Use a patching material supplied by the epoxy coating manufacturer that is compatible with the epoxy coating and inert in concrete. Follow the manufacturer's written recommendations regarding surface preparation and application. Provide those recommendations to the Engineer before field repairs are made. Apply the patching material to the damaged area only. Dipping the bar into the patching material, or liberally coating undamaged areas, is not allowed. Epoxy-coated bars with perforations, cracks, other damage, or improperly applied coatings will be rejected.

**C. LJT Support Assemblies.** Support one-piece LJT's in longitudinal joints between lanes placed simultaneously in assemblies or "baskets" that securely hold more than 1 LJT in position as detailed in Geometric Requirements below. Fabricate the assemblies using steel wire as depicted in the approved Materials Details. Affix 1 or both ends of each LTD to the assembly by welding or mechanical fixation within 50 mm of the end of the LJT.

**D. Corrosion Inhibitors for Threaded Connections (Multiple-piece LJT's Only).** Use one of the following:

- Medium setting asphalt emulsion meeting Table 702-5, Asphalt Emulsions.
- Thread-sealing compound approved by the Materials Bureau.

Apply the corrosion inhibitor to all threaded connections before the LJT's are assembled such that all surfaces of the assembled LJT are covered with an unbroken seal of epoxy coating or corrosion inhibitor.

Do not apply corrosion inhibitors to bolts that hold multiple-piece LJT's to forms.

**GEOMETRIC REQUIREMENTS.** Unless otherwise indicated in the contract documents, fabricate the support assemblies or bolt multiple-piece LJTs to forms such that the:

- Assembly holds at least 2 LJTs.
- Entire longitudinal axis of each bar is located at the middepth of the pavement slab ( $\pm 25$  mm).
- Longitudinal axes of the bars are aligned perpendicular to the pavement centerline and parallel with the pavement surface such that the maximum misalignment of 1 bar end relative to the other is 25 mm.
- Midpoint of the longitudinal axis of each bar is at the center of the joint ( $\pm 25$  mm).
- Longitudinal axes of adjacent bars do not exceed the maximum spacing identified in the contract documents.
- Bars are 75 mm (minimum) away from other LJTs or transverse joint supports.

## TESTS

**A. Materials Details – LJT Support Assemblies.** The LJT manufacturer must submit 3 Materials Details (shop drawings) to the Director, Materials Bureau, for review and approval before any other testing begins. The Materials Details must depict the following minimum information:

- Manufacturer's name, address, telephone number, fax number, and e-mail address.
- Drawing number.
- Support assembly dimensions and tolerances.
- LJT positioning within the joint support assembly.
- LJT ASTM steel grade designation.
- A cross section showing the relative positioning of LJTs to their support legs.
- Method used to affix LJTs to the support assembly and the locations of points of fixation.
- Methods used to affix wires together in the support assembly and the locations of points of fixation.
- Diameter of wires used in joint support assembly fabrication including wires used as assembly frames, LJT support legs, stakes, and spacer wires, if any.
- A detail of wire legs that hold LJTs to the support assembly.
- A detail of the stakes used to hold the supports to the underlying pavement layers during construction.
- The positioning and number of stakes required to hold the supports to the underlying pavement layers during construction. The minimum number of stakes must equal the number of LJTs in the assembly.

**B. Materials Details – Multiple-Piece LJTs.** The LJT manufacturer must submit 3 Materials Details (shop drawings) to the Director, Materials Bureau, for review and approval before any other testing begins. The Materials Details must depict the following minimum information:

- Manufacturer's name, address, telephone number, fax number, and e-mail address.
- Drawing number.
- Length of threaded ends.
- Thread size designations.
- LJT ASTM steel grade designation.
- Coupler dimensions and tolerances.
- Method used to affix LJTs to forms.

**C. Joint Support Assemblies.** Submit 2 complete LJT support assemblies and 6 loose, epoxy-coated LJTs to the Director, Materials Bureau, for conformance verification with the submitted Materials Details and this specification.

**D. One-Piece LJTs.** In addition to meeting Grade 420 yield strength requirements of the ASTM designation indicated on the Materials Details, epoxy-coated deformed bars must meet the Chemical Resistance, Cathodic Disbondment, Salt Spray Resistance, Coating Flexibility, Relative Bond Strength in Concrete, and Impact Test requirements of AASHTO M284 (ASTM A775), Epoxy Coated Steel Reinforcing Bars.

**E. Multiple-Piece LJTs.** Submit 12 multiple-piece LJTs to the Director, Materials Bureau, for conformance verification with the submitted Materials Details and this specification. When assembled, the multiple-piece ties shall have minimum yield strengths of 410 MPa. Also, multiple-piece LJTs must meet the Chemical Resistance, Cathodic Disbondment, Salt Spray Resistance, Coating Flexibility, Relative Bond Strength in Concrete, and Impact Test requirements of AASHTO M284 (ASTM A775), Epoxy Coated Steel Reinforcing Bars.

**BASIS OF ACCEPTANCE.** Longitudinal Joint Ties will be accepted at the contract based on the Manufacturer's appearance on the Department's Approved List entitled "Longitudinal Joint Ties (705-14)," under "Joint Materials, Pavement." The contractor shall provide 2 copies of each of the following to the Engineer:

- Approved Materials Details identified by drawing number and approval date as shown on the Approved List.
- Manufacturer's certification that the LJTs were manufactured in accordance with this specification and the submitted Materials Details.
- The name, address, telephone number, and e-mail address of the rolling mill that manufactured the LJTs and the mill's certification as to the type, grade, and ASTM designation of steel used in the LJTs.
- The brand name of the epoxy coating used on the LJTs and the name, address, telephone number, and e-mail address of the manufacturer.
- The name, address, telephone number, and e-mail address of the epoxy coating applicator and the applicator's certification that the coatings were applied in conformance to this specification.
- The brand name of the corrosion inhibitor for threaded coatings used on multiple-piece LJTs and the name, address, telephone number, and e-mail address of the manufacturer."

Make the following changes to the Standard Specifications of January 2, 2002.

Page 7-55

**Delete** Item 705-15 Transverse Joint Supports in its entirety and **replace** it with the following.

### **"705-15 TRANSVERSE JOINT SUPPORTS**

**SCOPE.** This specification details the requirements for load transfer devices (LTDs) and their support assemblies used at transverse joints in portland cement concrete (PCC) pavement.

**GENERAL.** All Transverse Joint Supports not referenced on the Department's Approved List entitled "Transverse Joint Supports (705-15)," under "Joint Materials, Pavement," will be subject to approval testing before their use is allowed on Department contracts. Submit approval applications to the Director, Materials Bureau, at least 120 days before their intended use. Approved supports will be placed on the Approved List and referenced by the drawing number and approval date. Any change to a previously approved transverse joint support requires approval by the Director, Materials Bureau before its use.

In case of conflict between the requirements of this specification and specifications referenced herein, the requirements of this specification or the instructions of the Director, Materials Bureau, will apply.

The Department may perform supplementary sampling and testing of the joint supports assemblies that arrive at Department contracts.

### **MATERIAL REQUIREMENTS**

**A. Dowels.** Dowels are the LTD component of transverse contraction and expansion joint support assemblies. They are also used at transverse construction joints. Obtain dowels from a manufacturer appearing on the Department's Approved List entitled "Reinforcing Bars (709-01)," under "Reinforcing, Steel."

Use 460 mm long dowels made of plain, Grade 420 steel bar reinforcement having uniform circular cross sections for their entire lengths. Saw cut dowel ends such that they are free of burrs or projections. Materials other than steel may be proposed, but their use is subject to the approval of the Director, Materials Bureau. Dowel diameters vary with pavement thickness as detailed in the Section 502 Standard Sheets. Coating thickness is not included in the dowel diameter.

**B. Deformed Bar Reinforcement.** Deformed bar reinforcement is the LTD component of transverse hinge joint support assemblies. Obtain bars from a manufacturer appearing on the Department's Approved List entitled "Reinforcing Bars (709-01)," under "Reinforcing, Steel." Use number 19 deformed bars, 600 mm long, made of Grade 420 steel. Materials other than steel may be proposed, but their use is subject to the approval of the Director, Materials Bureau.

**C. Coatings.** Steel LTDs (dowels and deformed bars) must be epoxy coated. Coatings other than epoxy (and their applicators) may be proposed, but their use is subject to the approval of the Director, Materials Bureau. Use an epoxy coating appearing on one of the following Approved Lists under, "Reinforcing, Epoxy and Coating:"

- Epoxy Coatings for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).

Apply the epoxy coating in accordance with "Coating Application" in §709-04, Epoxy Coated Bar Reinforcement, by an epoxy coating applicator appearing on one of the following Approved Lists under "Reinforcing, Epoxy and Coating:"

- Applicators for Steel Reinforcing Bars (709-04).
- Epoxy Coatings for Longitudinal Joint Ties (705-14).
- Epoxy Coatings for Dowel Bars for Transverse Joint Supports (705-15).

Coatings must be continuous over the length of the LTD and 0.25 mm – 0.45 mm thick, except for the cross-sectional ends, which may be uncoated. Field repair of damaged coatings is not allowed. Plant or facility repairs are not allowed unless the damage results from welding or mechanical fixation to the support assembly and is within 25 mm of the weld or fixation point. Such damage must be repaired before visible rust occurs. Use a patching material supplied by the epoxy coating manufacturer that is compatible with the epoxy coating and inert in concrete. Apply the patching material to the damaged area only. Dipping the LTD into the patching material, or liberally coating undamaged areas, is not allowed. Supports containing LTDs with perforated, cracked, otherwise damaged, or improperly applied coatings will be rejected.

Completely coat each dowel with a bond breaker applied at the epoxy coating applicator facility or the joint support assembly facility. The bond breaker is subject to approval by the Materials Bureau. Do not apply a bond breaker to deformed bar reinforcement.

**D. Premoulded Resilient Joint Filler (§705-07).** Use 10 mm – 15 mm thick filler in transverse expansion joint assemblies only.

**E. Joint Support Assemblies.** Support LTDs in assemblies or "baskets" that securely hold them in position as detailed in Geometric Requirements below. Fabricate the assemblies using steel wire as depicted in the approved Materials Details. Affix 1 end of each LTD to the assembly by welding or mechanical fixation. Affix alternating ends of adjacent LTDs to the assembly such that the point of fixation is within 50 mm of the end of the LTD.

## GEOMETRIC REQUIREMENTS

**A. Transverse Contraction Joints.** Unless otherwise indicated in the contract documents, fabricate the support assemblies such that the:

- Entire longitudinal axis of each dowel is located at the middepth of the pavement ( $\pm 6$  mm).
- Longitudinal axes of the dowels are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one dowel end relative to the other is 4 mm.
- Midpoint of the longitudinal axis of each dowel is at the center of the joint ( $\pm 25$  mm).
- Longitudinal axes of the two end dowels are 100 mm – 200 mm from the longitudinal joints.
- Longitudinal axes of the dowels are spaced 100 mm – 300 mm apart.

**B. Transverse Expansion Joints.** Fabricate the support assemblies such that the dowels are positioned in accordance with paragraph A, Transverse Contraction Joints. Include a one-piece premoulded resilient joint filler in the assembly that extends completely across the slab width. The joint filler must either equal the full depth of the slab, or extend from the bottom of the slab to within 40 mm – 50 mm of the top of the slab with a finishing cap that extends to the top of the slab.

Vertically support the filler at the longitudinal midpoints of the dowels and perpendicular to the longitudinal axes of the dowels. Depict support mechanisms in the Materials Details. Do not weld the dowels to filler supports.

Place plastic expansion caps on the free ends of the dowels (the ends opposite the fixed ends). Use expansion caps with essentially the same inner diameter as the outer diameter of the dowel plus coating thickness (+ 1 mm).

**C. Transverse Hinge Joints.** Unless otherwise indicated in the contract documents, fabricate the support assemblies such that the:

- Entire longitudinal axis of each deformed bar is located at the middepth of the pavement slab ( $\pm 25$  mm).
- Longitudinal axes of the deformed bars are aligned parallel with the pavement centerline and pavement surface such that the maximum misalignment of one bar end relative to the other is 25 mm.
- Midpoint of the longitudinal axis of each bar is at the center of the joint ( $\pm 25$  mm).
- Longitudinal axes of the two end bars are 100 mm – 300 mm from the longitudinal joints.
- Longitudinal axes of the bars are spaced 100 mm – 450 mm apart.

## TESTS

**A. Materials Details.** The transverse joint support manufacturer must submit 3 Materials Details (shop drawings) to the Director, Materials Bureau, for review and approval before any other testing begins. Depict only one type of joint on each detail submitted for approval. The Materials Details must depict the following minimum information:

- Manufacturer's name, address, telephone number, fax number, and e-mail address.
- Type of support (contraction, expansion, or hinge joint).
- Drawing number.
- Joint support assembly dimensions and tolerances.
- LTD length, spacing, and positioning within the joint support assembly.
- LTD ASTM steel grade designation.
- Bond breaker brand name and manufacturer.
- A cross section showing the relative positioning of LTDs to their support legs.
- Method used to affix LTDs to the support assembly and the locations of points of fixation.
- Methods used to affix wires together in the joint support assembly and the locations of points of fixation.
- Diameter of wires used in joint support assembly fabrication including wires used as assembly frames, LTD support legs, premoulded resilient joint filler supports (expansion joints only), stakes, and spacer wires that hold cages in place during transport.
- A detail of wire legs that hold LTDs to the support assembly.
- A detail of the stakes used to hold the supports to the underlying pavement layers during construction.
- The positioning and number of stakes required to hold the supports to the underlying pavement layers during construction.
- Methods used to support premoulded resilient joint fillers (expansion joints only).
- Expansion cap material and dimensions (expansion joints only).

**B. Joint Support Assemblies.** Submit 2 complete joint support assemblies and 6 loose, epoxy-coated LTDs to the Director, Materials Bureau, for conformance verification with the submitted Materials Details and this specification.

**C. Epoxy-Coated Dowels.** In addition to meeting the Grade 420 yield strength requirements of the ASTM designation indicated on the Materials Details, epoxy-coated dowels must meet the Load-Deflection, Pull-out, Abrasion, Corrosion, Chemical Resistance, Cathodic Disbonding, Coating Hardness, and Coating Impact Resistance requirements of AASHTO M254, Corrosion-Resistant Coated Dowel Bars, when tested in accordance with AASHTO T253, Coated Dowel Bars.

**D. Epoxy-Coated Deformed Bar Reinforcement.** In addition to meeting Grade 420 yield strength requirements of the ASTM designation indicated on the Materials Details, epoxy-coated deformed bars must meet the Chemical Resistance, Cathodic Disbondment, Salt Spray Resistance, Coating Flexibility, Relative Bond Strength in Concrete, and Impact Test requirements of AASHTO M284 (ASTM A775), Epoxy Coated Steel Reinforcing Bars.

**E. Field Test.** Only joint support assemblies meeting the above test requirements will be considered for trial installation in a field test. The supplier or manufacturer is responsible for coordinating the field test. The field test location may be:

- Part of a Department contract.
- Part of a contract under the jurisdiction of an agency other than the Department.
- A test site arranged by the supplier or manufacturer.

If the field test is outside New York State, the location must meet the approval of the Director, Materials Bureau.

If the field test is part of a Department contract, the Contractor must obtain the Engineer's approval before any support assemblies are installed. If the field test is at a test site arranged by the supplier/manufacturer, install the joint support assemblies in a 200 m long (minimum) pavement constructed in accordance with Section 502, Portland Cement Concrete Pavement. In any case, a minimum of 50 joints must be constructed using the joint supports.

Conduct field tests in the presence of Materials Bureau personnel. Specific attention will be given to handling, coating integrity, damage, alignment before and after paving, fixation failure, securing to underlying layers, contraction joint formation, and general specification conformance. Failing assemblies, and the pavement they are constructed into if part of a Department contract, will be rejected and removed and replaced at no cost to the State.

The Director, Materials Bureau, may waive field tests for hinge and expansion joint assemblies or from manufacturers who have an established history of successful contraction joint assembly installations with the Department.

**BASIS OF ACCEPTANCE.** Transverse joint supports will be accepted at the contract based on the Manufacturer's appearance on the Department's Approved List entitled "Transverse Joint Supports (705-15)," under "Joint Materials, Pavement." The contractor shall provide 2 copies of each of the following to the Engineer:

- Approved Materials Details identified by drawing number and approval date as shown on the Approved List.
- Manufacturer's certification that the joint supports were manufactured in accordance with this specification and the submitted Materials Details.
- The name, address, telephone number, and e-mail address of the rolling mill that manufactured the LTDs and the mill's certification as to the type, grade, and ASTM designation of steel used in the LTD.
- The brand name of the epoxy coating used on the LTDs and the name, address, telephone number, and e-mail address of the manufacturer.

- The name, address, telephone number, and e-mail address of the epoxy coating applicator and the applicator's certification that the coatings were applied in conformance to this specification.
- The brand name of the bond breaker used on the dowels and the name, address, telephone number, and e-mail address of the manufacturer."