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b. Layered Truck Mix (cement in contact with Saturated Surface Dry (SSD) or drier coarse aggregate). Batch the fine aggregate with admixtures, coarse aggregate and cement all separately. Load these materials through a hatch in the side of the drum in the following sequence: fine aggregate with admixtures, coarse aggregate, and cement last. The drum may be rocked after adding each aggregate size, but kept stationary while loading the cement. Begin mixing within 90 minutes of cement to coarse aggregate contact.

2. Mixing: Begin mixing at the discharge location. Add water to the drum either from the head section or by dual injection from both the head and discharge end. Mix for a minimum of 100 revolutions or until uniform concrete of the specified consistency is produced, whichever is longer. Do not exceed a 15 minute mixing period.

3. Discharge: Discharge the entire load within 30 minutes after mixing.

501-4 METHOD OF MEASUREMENT. The Engineer will compute the volume of concrete as the number of cubic meters within the payment lines indicated on the plans or as specified by the Engineer. No deductions will be made for the volume of embedded reinforcement, structural shapes or joint materials. Also, no deductions will be made in concrete pavement for catch basins, manholes, etc. unless otherwise indicated in the contract documents.

501-5 BASIS OF PAYMENT. Include the cost of furnishing all materials, equipment and labor necessary to complete the work in the unit price bid for the appropriate items.

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

<table>
<thead>
<tr>
<th>Material</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portland Cement Concrete</td>
<td>501</td>
</tr>
<tr>
<td>Anchoring Materials - Chemically Curing</td>
<td>701-07</td>
</tr>
<tr>
<td>Premoulded Resilient Joint Filler</td>
<td>705-07</td>
</tr>
<tr>
<td>Preformed Elastic Longitudinal Joint Sealer</td>
<td>705-10</td>
</tr>
<tr>
<td>Preformed Elastic Transverse Contraction and Expansion Joint Sealers</td>
<td>705-12</td>
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<tr>
<td>Lubricant for Preformed Elastic Joint Sealer</td>
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<tr>
<td>Longitudinal Joint Ties</td>
<td>705-14</td>
</tr>
<tr>
<td>Transverse Joint Supports</td>
<td>705-15</td>
</tr>
<tr>
<td>Wire Fabric for Concrete Reinforcement</td>
<td>709-02</td>
</tr>
<tr>
<td>Epoxy Coated Bar Reinforcement, Grade 420</td>
<td>709-04</td>
</tr>
<tr>
<td>Quilted Covers (for curing)</td>
<td>711-02</td>
</tr>
<tr>
<td>Plastic Coated Fiber Blankets (for curing)</td>
<td>711-03</td>
</tr>
<tr>
<td>Polyethylene Curing Covers (white opaque)</td>
<td>711-04</td>
</tr>
<tr>
<td>Membrane Curing Compound</td>
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<tr>
<td>Form Insulating Materials for Winter Concreting</td>
<td>711-07</td>
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<tr>
<td>Water</td>
<td>712-01</td>
</tr>
<tr>
<td>Silicone Sealants</td>
<td>Approved List</td>
</tr>
<tr>
<td>Highway Joint Sealants (ASTM D3405)</td>
<td>Approved List</td>
</tr>
<tr>
<td>Backer Rods</td>
<td>ASTM D 5249</td>
</tr>
</tbody>
</table>

In addition to meeting the requirement of ASTM D5249 (Type 1 or 3), backer rods must be closed cell polyethylene foam with a diameter 25% wider than the saw cut depicted in the Standard Sheets.

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:
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- 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 joint sealants that appear on the Approved List. 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. Class F concrete 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 m³ (minimum) trial batch at an off-project location approved by the Engineer. Produce the trial batch using the same materials and processes as those to be used to produce the project concrete. Provide the Engineer a 7 day minimum advance notification of trial batch production. Coordinate trial batch production to ensure 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.
- Cast cylinders 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 35 days of trial batch production. Changes other than minor fluctuations in admixture dosage rates require a new mix design and trial batch. The Engineer may halt paving and order additional trial batches whenever the specified properties are not achieved.

<table>
<thead>
<tr>
<th>TABLE 502-1 HIGH-EARLY-STRENGTH CONCRETE MIX REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property</td>
</tr>
<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>28 Day Compressive Strength</td>
</tr>
<tr>
<td>Opening Compressive Strength</td>
</tr>
<tr>
<td>Plastic Air Content</td>
</tr>
<tr>
<td>Hardened Air Content</td>
</tr>
<tr>
<td>Water - Cement Ratio (w/c)</td>
</tr>
<tr>
<td>Slump²</td>
</tr>
</tbody>
</table>

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.
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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/m³
- Aggregate 1600 kg/m³
- w/c 0.37 max

Aggregate weight is based on a dry-rodred density of 1600 kg/m³ and a saturated, surface-dry condition. Adjust the aggregate weight accordingly if the project aggregate has a different dry-rodred density.

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 24 business hours before its use to allow examination by the Engineer. A business hour is any hour, Monday through Friday, excluding New York State recognized holidays. 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. Slip Form Paving. Use a self-propelled slip form 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.

Slip form 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.

<table>
<thead>
<tr>
<th>TABLE 502-2 FORM REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic</td>
</tr>
<tr>
<td>----------------</td>
</tr>
<tr>
<td>Material</td>
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<tr>
<td>Length</td>
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<tr>
<td>Depth</td>
</tr>
<tr>
<td>Base Width</td>
</tr>
<tr>
<td>Horizontal Top Face</td>
</tr>
<tr>
<td>Vertical Face</td>
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<tr>
<td>Flange Bracing</td>
</tr>
</tbody>
</table>

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NEW YORK STATE DEPARTMENT OF TRANSPORTATION
STANDARD SPECIFICATIONS of January 2, 2002
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. 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 nonprofiigraphed, §502-3.16, Profiograph, 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.

3. Paving Irregular Areas. Pave with the following equipment, in order of preference, if slip form 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. Place permeable base with pavers meeting §502-2.04A, Slip Form Paving, or §402-3.02, HMA Pavers. In a fixed form operation with permeable base placed within the forms, the permeable base may be placed by hand and compacted with plate or small drum vibrators.

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 days before paving.
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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 slip form paving operation, use self-propelled applicators guided by the same reference system as the slip form 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. Provide the means to transport the profilograph.

H. Diamond Grinding. Use equipment having gang-mounted diamond saw blades on a multiblade arbor specifically designed for pavement bump cutting or production grinding. Use production grinding equipment capable of producing a 900 mm (minimum) grinding pass width that is equipped with a vacuum system capable of removing slurry from the pavement surface, such as the Target 3800 or Target 3804, or equal, as approved by the Director, Materials Bureau. Submit requests to use other equipment at least 7 days before grinding.

I. Drills. Use hydraulic gang drills with a minimum of 2 independently powered and driven drills. Use tungsten carbide drill bits. Control the forward and reverse drill travel by mechanically applied pressure. Mount the drill on a suitable piece of equipment such that it is quickly transported and positioned. 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 on the surface being drilled. Hand-held drills are not permitted.

J. Joint Sealing (Silicone). 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 Filling. 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 unit with positive temperature control, mechanical agitation, re-circulation pumps, and separate thermometers to indicate the temperature of the heat transfer medium and the joint sealant material in the hopper. Do not fill any joint 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 temperature. Use nozzles that apply the joint sealant within the joint confines for the full width of the joint, 5 mm to 7 mm below the pavement surface.

502-3 CONSTRUCTION DETAILS. Convene a prepping 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.
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Construct a smooth, well consolidated, properly finished, textured, and cured pavement to the line and grade depicted in the contract documents, ± 6 mm at any location. Construct irregular areas in separate placements. Operate paving equipment such that hand finishing is kept to a minimum.

Submit alternate construction techniques and/or materials to the Engineer for approval. Discontinue the use of alternate construction techniques and/or materials if unsatisfactory results are obtained.

502-3.01 Weather Limitations

A. Rain. Do not pave in the rain. Supply sufficient covers meeting §711-02, Quilted Covers; §711-03, Plastic Coated Fiber Blankets; or §711-04, 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. Discontinue paving when the air temperature falls below 4°C. Measure temperatures in the shade to an accuracy of ± 1°C.

Supply insulating boards or blankets meeting §711-07, Form Insulating Materials for Winter Concreting, when the air temperature is expected to fall below 4°C at any time during the curing period defined in §502-3.11, Curing. Use insulating material capable of maintaining a surface temperature of 13°C and being easily removed and replaced to accommodate first-stage saw cuts. Provide recording thermometers as required in §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. Extend the prepared subbase course at least 300 mm beyond the outside edge of either the slip form paving equipment track or the fixed forms.

502-3.03 Portland Cement Treated Permeable Base. Apply §502-3.01, Weather Limitations. Place and consolidate permeable base a slip form paver with vibrators disengaged or a bituminous paver with an attached vibrating screed. In areas not accessible to pavers, spread permeable base by hand and consolidate with plate or small drum vibrators. Place and consolidate permeable base within 2 hours of water addition to the dry mixed components. 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 slip form 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 slip form 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
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replace damaged or contaminated permeable base before placing PCC.

502-3.04 Slip Form Paving. Use equipment meeting §502-2.04A, Slip Form Paving. Establish a reference system to achieve the specified smoothness level. If string lines are used, set them by survey and use dual lines whenever possible. 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 the paver track clear of concrete and debris before and during paving.

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 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 straightedge over the pavement edge. Immediately correct edge slumps greater than 6 mm.

502-3.05 Fixed Form Paving.

A. Setting Forms. Use forms meeting §502-2.04B1, Forms. Compact the supporting layer at the form line such that the forms are firmly 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.

Clean and oil forms before use. Set forms to accommodate a full day’s 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. Use equipment meeting §502-2.04B2, Paving Machines. Immediately before placing concrete, thoroughly 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 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 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.

Mark the midpoint (± 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
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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. Use equipment meeting §502-2.04B3, Paving Irregular Areas. Uniformly place and 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 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 and any honeycombed areas. Remove forms before making second-stage saw cuts.

502-3.06 Joint Construction. Construct joints in accordance with the Standard Sheets and approved Materials Details for transverse joint assemblies. 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 days prior to PCC paving. Obtain the Engineer’s joint layout approval before PCC paving. Clean and seal or fill joints in accordance with §502-3.12, Sealing or Filling Joints.

A. Transverse Joints. Transverse joints include contraction, expansion, and construction joints. Provide the Engineer approved Materials Details in accordance with §705-15, Transverse Joint Supports, before placing any transverse contraction or expansion joint assemblies. Construct transverse joints:

- In a straight line across the full width of the PCC pavement and shoulders, unless the transverse joint intersects an untied longitudinal joint as discussed in §502-3.06B3, Untied Longitudinal Joints With Keyway.
- Perpendicular to the pavement surface and centerline.

Store transverse contraction joint supports assemblies in inverted stacks at the project site. Handle transverse joint supports such that no twisting or bending occurs during storage and positioning. The Engineer will reject supports with bent, twisted, or deformed wires. 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 (±6mm),
- 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 (± 25 mm).
- Longitudinal axes of the two end dowels are 100 mm - 150 mm from the longitudinal joints.
- Longitudinal axes of the dowels are spaced 300 mm, maximum, apart.

Use a 5.0 m typical transverse joint spacing for 3.6 m and 4.2 m typical slab widths. Space transverse joints at 3.0 - 5.5 m intervals in accordance with the contract documents to accommodate nontypical lane widths, utilities, drainage structures, and irregular areas. Secure joint supports to the subbase as depicted in the Materials Details. Maintain joint supports in their proper position and alignment during paving. Do not step on joint supports. Immediately before concrete placement, cut the tie wires (parallel to the dowels) that hold the 2 upper transverse support
members in position. Cut each tie wire twice, once near each weld. Submit alternate methods to place and secure transverse joint supports to the Director, Materials Bureau, for approval.

1. **Transverse Contraction Joints.** All transverse joints are contraction joints unless otherwise shown in the contract documents. Mark the location of each contraction joint. In a slip form paving operation, mark the joint midpoint on the subbase or permeable base immediately adjacent to the pavement. In a fixed form paving operation, mark the joint with shims as discussed in §502-3.05B, Paving.

Construct contraction joints as depicted in the contract documents. Use equipment specified in §502-2.04E, Saw Cutting Equipment. Perform first-stage saw cuts in one pass as soon as the concrete has hardened sufficiently to permit sawing without causing raveling wider than 3 mm. Replace blades if raveling persists after the concrete has gained sufficient strength. 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. Make first-stage saw cuts in succession down the pavement. Do not perform first-stage saw cuts on every other joint and return later to saw omitted joints.

Make second-stage saw cuts and bevels, if required, no sooner than 72 hours after concrete placement. Second-stage saw cuts may be delayed for convenience. Immediately after performing second-stage saw cuts, wash the resulting slurry from the joint.

2. **Transverse Expansion Joints.** Construct transverse expansion joints:

- On both sides of a bridge or culvert having an at-grade top slab and no other specified pressure relief joints. In this case, construct expansion joints at the first two joint locations starting at, and including, the joint between the structure approach slab and the pavement.
- As part of the utility and drainage structure isolation systems depicted in the Standard Sheets.
- Where indicated in the contract documents.

Construct expansion joints using 10 mm thick premoulded resilient joint filler placed in one piece between longitudinal joints. Tightly place and support abutting sections of joint filler such that no concrete infiltrates the joint. 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. Rout and bevel the joint as depicted in the Standard Sheets no sooner than 72 hours after concrete placement.

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 one or two 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. Do not use the hollow cylinder system when constructing a construction joint adjacent to previously placed concrete. Use hollow cylinders with an inner diameter 0.80 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 §502-3.06A, Transverse Joints,
with closed ends on the “leave” side of the support relative to the paving direction.

Pave beyond the joint support containing the hollow cylinders and immediately remove plastic concrete back to the joint assembly. After the concrete has gained sufficient strength to prevent damage, saw cut the newly placed concrete full depth and full width through the midpoint of the longitudinal axis of each cylinder (± 25 mm). Remove hardened 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 §502-3.06A, Transverse Joints, and resume paving. First-stage saw cuts are not required at construction joints. Make second-stage saw cuts and bevels, if required, as described in §502-3.06A1, Transverse Contraction Joints.

B. Longitudinal Joints. Locate and construct longitudinal joints in accordance with the contract documents. Where ties are required, select a type, size, spacing, and positioning in accordance with the contract documents. 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 the Standard Sheets. Do not place a tie within 375 mm of a transverse joint. Keep ties free of materials deleterious to bond. Saw cut joints, where required, parallel to the pavement centerline and perpendicular to the pavement surface.

1. Longitudinal Joints Between Lanes Paved Simultaneously. Use one-piece ties either (1) positioned on chairs or in baskets and secured to the subbase prior to placing the concrete or (2) inserted into the plastic concrete with an automatic inserter. Maintain ties in their proper position during paving. Do not step on the ties.

Construct the joints as depicted in the contract documents. Use equipment specified in §502-2.04E, Saw Cutting Equipment. Make first-stage longitudinal saw cuts (1) within 24 hours of concrete placement and (2) immediately 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.

Perform second-stage saw cuts, if required, (1) no sooner than 72 hours after concrete placement and (2) at the end of the curing period if blankets or covers are used for curing. Second-stage saw cuts may be delayed for convenience.

2. Tied Longitudinal Joints Between Lanes Paved Separately. In a slip form operation, construct either a butt joint or a keyed joint. The Engineer may require a butt joint if the concrete can not be adequately consolidated in the key way. Butt joints may require additional ties, refer to the Standard Sheets.

In a slip form operation, use either two- or three-piece ties inserted into the plastic concrete or one-piece ties drilled and anchored into the hardened concrete. When using multiple-piece ties, insert the female tie components with protective plugs into the plastic concrete using a hydraulic or manual side bar inserter. Remove the plug and clean the threads after the concrete has gained sufficient strength. Apply a corrosion inhibiting coating to the threads of all components before assembly in accordance with §705-14, Longitudinal Joint Ties. Insert and tighten the male ends before paving the adjacent lane. Ensure all threaded connections are tight.

When drilling and anchoring one-piece ties into hardened concrete, use equipment meeting §502-2.04I, Drills. Drill and anchor longitudinal joint ties in butt joints only. Use # 19 ties, 700 mm long. Anchor ties 300 mm into the previously placed concrete, leaving 400 mm projecting from the existing face. Place the end ties in a slab 375 mm from the transverse joints. Space ties between the end ties 600 mm apart, maximum.

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. Repair any damage to the existing concrete that results from drilling. 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, clean the drilled holes with oil-free and moisture-free compressed air. The Engineer will check the compressed air stream purity with a clean white cloth. Use a compressor that delivers air at a minimum of 3.4 m³ per minute and develops a minimum nozzle pressure of 0.63 MPa. Insert the 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 a keyed joint. Bolt the female portion of the tie to the form prior to paving as depicted in the Standard Sheets. Connect the male end after form removal and before paving the adjacent lane.

First-stage saw cuts are not required between lanes paved separately for any joint type. Make second-stage saw cuts, if required, (1) no sooner than 72 hours after the later concrete placement or (2) at the end of the curing period if blankets or covers are used for curing. Second-stage saw cuts may be delayed for convenience.

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.

Saw cut in accordance with §502-3.06B2, Tied Longitudinal Joints Between Lanes Paved Separately.

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. Saw cut longitudinal portions of the isolation joint systems in accordance with §502-3.06B2, Tied Longitudinal Joints Between Lanes Paved Separately. 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. Remove any concrete that spills onto the existing concrete such that the texture and smoothness of the existing concrete are not compromised.

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 slip form paving operation, anchor flat, thin (16 gauge or 1.52 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. Keep several probes at the project.

In a slip form paving operation, the measured plastic thickness must equal or exceed the thickness required in the contract documents. Areas having a substandard thickness will be treated in accordance with §502-3.14, Damaged or Defective Concrete. If 2 consecutive substandard thicknesses are obtained, 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 correct significant bumps by hand finishing. Hand finish with wood, magnesium, or cadmium floats, lutes, and/or trowels. 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 additional water becomes routinely necessary to close imperfections.

502-3.10 Texturing. Immediately after finishing and prior to applying the curing compound, texture the concrete surface perpendicular to the pavement center line with a set of variable 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:


Produce tine texture 3 mm - 4 mm deep with minimal dislodging of aggregate. Do not make multiple tine passes in the same area.

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. 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. Cure the entire pavement immediately after texturing. Stop paving if water is not used when required. 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. Refer to Table 502-3, Class C Concrete Curing Requirements. Cure Class F concrete for 3 days, minimum. Cure alternate mixes in accordance with Materials Bureau requirements.

A. White Pigmented Membrane Curing Compound. Cure concrete placed between April 1 and October 15 with white pigmented membrane curing compound. Use equipment meeting §502-2.04F, Curing Compound Applicators. Mix the curing compound before each use and
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continuously agitate during use. Thoroughly and uniformly coat all exposed surfaces (including slip formed edges and formed edges immediately after form removal) at a minimum rate of 3.5 m³/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 dries.

**B. Curing Covers.** If the provisions of §502-3.11C, Cold Weather Curing, do not apply, cure concrete placed between October 16 and March 31 with curing covers. 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. Remove and replace concrete damaged by cold weather.

**TABLE 502-3 CLASS C CONCRETE CURING REQUIREMENTS**

<table>
<thead>
<tr>
<th>Placement Dates</th>
<th>Cold Weather Applicable</th>
<th>Minimum Curing Period</th>
<th>Curing Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/1 - 5/31</td>
<td>No</td>
<td>6 Days</td>
<td>White Pigmented</td>
</tr>
<tr>
<td>4/1 - 5/31</td>
<td>Yes</td>
<td>6 Days</td>
<td>Form Insulating Material</td>
</tr>
<tr>
<td>6/1 - 9/15</td>
<td>-</td>
<td>4 Days</td>
<td>White Pigmented</td>
</tr>
<tr>
<td>9/16 - 10/15</td>
<td>-</td>
<td>6 Days</td>
<td>White Pigmented</td>
</tr>
<tr>
<td>10/16 - 3/31</td>
<td>No</td>
<td>6 Days</td>
<td>Curing Covers</td>
</tr>
<tr>
<td>10/16 - 3/31</td>
<td>Yes</td>
<td>6 Days</td>
<td>Form Insulating Material</td>
</tr>
</tbody>
</table>

**502-3.12 Sealing or Filling Joints.** When a sealing item is specified, use either preformed elastic joint sealer or silicone, unless sealer type is specified in the contract documents. Seal joints as depicted in the Standard Sheets. Construct joints in accordance with §502-3.06, Joint Construction.

Remove first-stage saw cut debris from the pavement within 24 hours of saw cutting and before:
- Profilographing.
Sweep the pavement when it is opened to construction traffic and the joints are unfilled or unsealed. Before cleaning, 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. Refer to Table 502-4, Joint Sealing Alternatives.

**A. Filling Transverse Contraction Joints.** Make first-stage saw cuts sufficiently wide to allow full-depth filling with a Highway Joint Sealant, but no wider than 6 mm. Joint cleaning and filling may be delayed for convenience. Do nothing at transverse construction joints or longitudinal joints when Filling Transverse Contraction Joints is specified.

Clean the joints by abrasive blasting or pressure washing before filling. 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. Within 24 hours of 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 filling. Reclean the joint if it rains between cleaning and filling.

Give the Engineer a copy of the sealant Manufacturer's recommendations for heating and application at least 24 business hours before filling. Follow those recommendations unless modified by this specification. The recommended pouring temperature is 5°C below the manufacturer's designated safe heating temperature, with an allowable variation of ± 5°C. Do not use sealant:

- Heated above the safe heating temperature.
- Heated at the pouring temperature in excess of 6 hours.
- That has been reheated.

Fill joints within 6 hours of cleaning and before opening to general traffic. Use equipment meeting the requirements of §502-2.04K, Joint Filling. Fill the joint from the bottom of the cut to within 5 mm - 7 mm of the pavement surface. Fill when the:

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

Use a hot air lance to dry the vertical joint surfaces if sealant is applied sooner than 24 hours after rain. Open to traffic after the sealant has cured to prevent tracking.

**B. Sealing Joints - Silicone Sealant.** Make second-stage saw cuts and/or bevels in accordance with the Standard Sheets and §502-3.06, Joint Construction. Wash the resulting slurry from the pavement and joint immediately after making second-stage saw cuts and/or bevels. Clean and seal joints immediately after second-stage saw cutting. Second-stage saw cuts may be delayed for convenience, but do not leave second-stage saw cuts unsealed or unfilled. Temporarily fill second-stage saw cuts with jute or backer rod if weather conditions are not favorable for immediate cleaning and sealing, whether or not the pavement is open to traffic.

Thoroughly abrasive blast all vertical joint faces before scaling. 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. Use air blasting equipment with traps or other devices installed to prevent moisture and oil from contaminating the joint surface.

Use equipment meeting §502-2.04J, Joint Sealing (Silicone). 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. Seal when the:

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

Use a hot air lance to dry the vertical joint surfaces if sealant is applied sooner than 24 hours after rain. Before sealing, install the 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.

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 §502-3.06, Joint Construction. Wash the resulting slurry from the pavement and joint immediately after making second-stage saw cuts and/or bevels. Clean and seal joints immediately after second-stage saw cutting. Second-stage saw cuts may be delayed for convenience, but do not leave second-stage saw cuts unsealed or unfilled. Temporarily fill second-stage saw cuts with jute or backer rod if weather conditions are not favorable for immediate cleaning and sealing, whether or not the concrete is open to 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. Do not allow any traffic on the pavement between cleaning and sealing. Re-clean the joint if it rains between cleaning and sealing.

Extend the second-stage saw cut vertically down the free concrete edges. 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.

**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.
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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. Slip formed concrete with substandard plastic thickness as described in

<table>
<thead>
<tr>
<th>Joint Type</th>
<th>Sealing Alternative</th>
<th>First-Stage Saw Cut Required</th>
<th>Second-Stage Saw Cut and Bevel Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transverse Contraction</td>
<td>Seal</td>
<td>Yes</td>
<td>Both</td>
</tr>
<tr>
<td>Transverse Expansion and Isolation</td>
<td>Fill</td>
<td>Yes</td>
<td>Neither</td>
</tr>
<tr>
<td>Transverse Construction</td>
<td>Seal Only</td>
<td>No</td>
<td>Bevel Only</td>
</tr>
<tr>
<td>Longitudinal - Between Lanes Placed</td>
<td>Seal</td>
<td>Yes</td>
<td>Second-Stage Only</td>
</tr>
<tr>
<td>Separately and Untied Joints With Keyway</td>
<td>Do Nothing</td>
<td>No</td>
<td>Neither</td>
</tr>
</tbody>
</table>

§502-3.08, Plastic Thickness Determination, will be rejected in 50 m segment lengths.

502-3.15 Hardened Surface Test (Nonprofilographed Projects). 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. Deviations exceeding 10 mm in 3 m will be considered defective concrete subject to the provisions of §502-3.14, Damaged or Defective Concrete. Diamond grind deviations up to 10 mm in 3 m 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 projects and nonprofilographed projects when a full-width finishing pan or triple transverse screed paving operation is not employed, as discussed in §502-2.04B2, Paving Equipment.

Use equipment meeting §502-2.04G, Profilograph. Provide traffic control and survey stationing for referencing measurements. The Engineer will divide the pavement into 160 m long reporting segments, but may group segments shorter than 160 m with previous or subsequent placements. The reporting segment width is the placement width. Develop a profile trace and determine an initial profile index (PI) for each travel lane of each reporting segment. Obtain the trace along the longitudinal center of the travel lane in accordance with Materials Method 24, PCC Pavement Profilograph Operations. Develop a referencing system that allows the Engineer to readily associate a trace and an initial PI to the actual corresponding reporting segment travel lane. Give 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
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reporting segment, the initial PI may be used to determine the payable Quality Units of Smoothness Quality Adjustment per reporting segment, as discussed in §502-4.04, Smoothness Quality Adjustment. Then, up to 10% of any reporting segment’s surface area may be ground to increase the amount of Quality Units payable. This 10% includes areas ground to remove bumps exceeding 10 mm in 7.6 m. Whether diamond grinding was required through profile trace analysis, or performed as a Contractor option, reprofilograph the pavement and determine a final PI for each travel lane of each reporting segment. Give the Engineer the final profile traces and final PI determined by using both the 5 mm and zero blanking bands.

The Engineer will report the final PI and payable Quality Units, if any, for each segment as discussed in §502-4.04, Smoothness Quality Adjustment. No Quality Units will be paid for a reporting segment if more than 10% of the segment’s surface area requires diamond grinding to achieve the minimum acceptable PI. If more than 20% of a reporting segment’s surface area requires diamond grinding to achieve the minimum acceptable PI, production grind the entire segment such that the minimum PI is achieved for the segment.

502-3.17 Diamond Grinding. Use equipment meeting §502-2.04H, Diamond Grinding. Begin and end diamond grinding at lines normal to the pavement centerline. Grind the pavement longitudinally. For production grinding, grind at least 95% surface area. Provide surface drainage by maintaining the proper cross slope on the finished surface and by blending adjacent passes. Regrind the pavement if an acceptable surface is not being obtained.

If required in the contract documents, continuously remove the slurry from the pavement using the vacuum system on the grinding equipment. Transfer the slurry into equipment capable of transporting it from the job site without spills. Do not allow slurry discharge into:

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

Dispose slurry in conformance with all Federal, State, and local regulations.

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.

Irregular areas may be paved after the adjacent Class C concrete has been in place for 3 days provided the adjacent concrete is not exposed to construction traffic.

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 or Filling 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 number 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. Class F Concrete. Class F concrete may be opened to construction traffic 3 days after placement. Class F concrete may also be opened to general traffic after 3 days provided the joints are addressed in accordance with §502-3.12, Sealing or Filling Joints.

E. HES Concrete. HES concrete may be opened to construction traffic and general traffic when it has achieved 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 or Filling Joints.

§502-4 METHOD OF MEASUREMENT. The Engineer will compute the following quantities for items incorporated into the finished pavement in accordance with the contract documents:

502-4.01 Portland Cement Treated Permeable Base. Cubic meters from the payment lines shown in the contract documents and linear measurements made longitudinally on the finished permeable base surface. No deductions will be made for catch basins, manholes, or other similar pavement obstructions.

502-4.02 PCC Pavement, Unreinforced, All Types and Classes. Cubic meters from the payment lines shown in the contract documents and linear measurements made longitudinally on the finished pavement surface. Deductions in 50 m segment lengths will be made for areas with substandard thicknesses as described in §502-3.08, Plastic Thickness Determination. 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 Isolated PCC Pavement, Mesh or Heavily Reinforced, All Classes. Cubic meters from the finished surface area and the placement thickness. No deductions will be made for drainage and utility structures or other similar pavement obstructions being isolated from the surrounding pavement.
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502-4.04 Smoothness Quality Adjustment (Profilographed Items Only). Quality Units of Smoothness Quality Adjustment, if any, payable for each reporting segment determined by the following:

Quality Units (Per Segment) = (SAF - 1.00) x PCC Cubic Meters (Per Segment)

The Smoothness Adjustment Factor (SAF) from Table 502-5, Smoothness Adjustment Factors, is based on the final PI obtained for each reporting segment in accordance with §502-3.16, Profilograph. Refer to §502-3.16, Profilograph, for diamond grinding limits on Quality Unit determination. No Quality Units are computed for pavements originally specified as nonprofilographed as discussed in §502-2.04B2, Paving Equipment.

<table>
<thead>
<tr>
<th>Final Profile Index (mm/km.)</th>
<th>Level 1 SAF</th>
<th>Level 2 SAF</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0 - 16.0</td>
<td>1.05</td>
<td>1.05</td>
</tr>
<tr>
<td>16.1 - 32.0</td>
<td>1.04</td>
<td>1.04</td>
</tr>
<tr>
<td>32.1 - 48.0</td>
<td>1.03</td>
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</tr>
<tr>
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502-4.05 Constructing Transverse Joints, All Types. Meters of transverse contraction, expansion, construction, and isolation joints.

502-4.06 Constructing Longitudinal Joints, All Types. Meters of longitudinal joints between lanes placed simultaneously, tied longitudinal joints between lanes placed separately, and untied longitudinal joints with keyways.

502-4.07 Sealing or Filling Transverse Joints, All Types. Meters of sealed or filled transverse contraction, expansion, construction, and isolation joints, excluding preformed sealers turned down at the pavement edges.

502-4.08 Sealing Longitudinal Joints, All Types. Meters of sealed longitudinal joints between lanes placed simultaneously, tied longitudinal joints between lanes placed separately, and untied longitudinal joints with keyways.

502-5 BASIS OF PAYMENT

502-5.01 Portland Cement Treated Permeable Base. In the unit bid price, include the cost of all materials, equipment, and labor necessary to place and consolidate the permeable base.

502-5.02 PCC Pavement, Unreinforced, Nonprofilographed, All Classes. In the unit bid price, include the cost of all materials, equipment, and labor necessary to place, spread, consolidate, finish, texture, cure, test, straight edge, and diamond grind the portland cement concrete pavement. No payment will be made for areas with substandard thicknesses as described in §502-3.08, Plastic Thickness Determination. No additional payment will be made for Contractor-requested HES concrete mixes.
Also include the cost of all materials, equipment, and labor necessary to profilograph and diamond grind the pavement to meet the Level 2 smoothness requirements of §502-4.04, Smoothness Quality Adjustment, if paving equipment other than a paver equipped with a full-width finishing pan or triple transverse screeds is used as discussed in §502-2.04B2, Paving Equipment. No payment will be made for SAF Quality Units.

Progress payments will be made after the pavement has been properly and completely constructed, including joint sealing or filling and diamond grinding, if required. Payment will be made at the unit bid price for 90% of the quantity placed. The balance will be paid upon completion of any necessary repairs.

502-5.03 PCC Pavement, Unreinforced, Profilographed. In the unit bid price, include the cost of all materials, equipment, and labor necessary to place, spread, consolidate, finish, texture, cure, test, profilograph, and diamond grind the portland cement concrete pavement. No payment will be made for areas with substandard thicknesses as described in §502-3.08, Plastic Thickness Determination. No additional payment will be made for Contractor-requested HES concrete mixes.

Progress payments will be made after the pavement has been properly and completely constructed, including joint sealing and diamond grinding, if required. Payment will be made at the unit bid price for 90% of the quantity placed. The balance will be paid upon completion of any necessary repairs.

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 Isolated PCC Pavement, Mesh or Heavily Reinforced, All Classes. In the unit bid price, include the cost of all materials, equipment, forms, reinforcing steel, and labor necessary to form, reinforce, place, spread, consolidate, finish, texture, cure, test, straight edge, profilograph, and diamond grind the reinforced portland cement concrete pavement. No additional payment will be made for Contractor-requested HES concrete mixes.

502-5.06 Constructing Transverse Joints, All Types. In the unit bid price, include the cost of all materials, equipment, and labor necessary to construct any transverse joint, including the cost of transverse joint supports depicted in the approved Materials Details, first-stage saw cutting to establish contraction joints, premoulded resilient joint filler at isolation joints, and hollow cylinder joint supports, bulkheads, full-depth saw cuts, and concrete removal at construction joints.

502-5.07 Constructing Longitudinal Joints, All Types. In the unit bid price, include the cost of all materials, equipment, and labor necessary to construct any longitudinal joint, including the cost of first-stage saw cutting between lanes placed simultaneously, applying form oil, affixing keyways to forms, special keyway construction for untied longitudinal joints, longitudinal joint ties, bolting multiple-piece ties to forms, drilling holes between lanes placed separately, cleaning holes, anchoring material, field coating ties, and preparing and assembling multiple-piece ties. Placing the inside shoulder and inside lane simultaneously, at the Contractor’s, 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 slip form paving operation.

502-5.08 Sealing Transverse Joints, All Types. In the unit bid price, include the cost of all materials, equipment, and labor necessary to seal any transverse joint, including second-stage saw cutting and beveling of contraction and construction joints, routing and beveling isolation and expansion joints, washing slurry from the pavement, abrasive blasting, air blasting, drying, bonding agents, sealant, and tooling silicone sealant.
§502-5

502-5.09 Filling Transverse Contraction Joints. In the unit bid price, include the cost of all materials, equipment, and labor necessary to fill transverse contraction joints, including water blasting, manual dislodging of debris, air blasting, drying, and highway joint sealant. No additional payment will be made for additional widening of first-stage saw cuts to accommodate highway joint sealant placement.

502-5.10 Sealing Longitudinal Joints, All Types. In the unit bid price, include the cost of all materials, equipment, and labor necessary to seal any longitudinal joint including second-stage saw cutting, washing slurry from the pavement, abrasive blasting, air blasting, drying, bonding agents, backer rod, sealant, and tooling silicone sealant. 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:

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Pay Unit</th>
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<tr>
<td>502.0001 M</td>
<td>Portland Cement Treated Permeable Base</td>
<td>Cubic Meter</td>
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<tr>
<td>502.RPC0 M</td>
<td>PCC Pavement</td>
<td>Cubic Meter</td>
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R - Pavement & Reinforcement
- Unreinforced
- Isolated, Mesh Reinforced
- Isolated, Heavily Reinforced

P - Profilographing
- Nonprofilographed
- Level 1
- Level 2

C - Concrete Class
- Class C
- Class F
- HES

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<th>Item No.</th>
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<td>502.93 M</td>
<td>Sealing Longitudinal Joints</td>
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SECTION 503 - PORTLAND CEMENT CONCRETE FOUNDATION FOR PAVEMENT

503-1 DESCRIPTION. This work shall consist of constructing an unreinforced portland cement concrete foundation for pavement, on a prepared subbase in accordance with these specifications, in substantial conformance with the established grades and typical cross-sections shown on the plans or established by the Engineer.

503-2 MATERIALS. Materials shall meet the requirements of the following subsections:

- Portland Cement Concrete
- Quilted Covers (for curing)
- Plastic Coated Fiber Blankets (for curing)
- Polyethylene Curing Covers (white opaque)

In addition to the material requirements listed, the following Department standard sheets for Longitudinal Joint Ties shall apply unless otherwise specified on the plans or in the proposal.

503-3 CONSTRUCTION REQUIREMENTS. The construction requirements of Section 502, Portland Cement Concrete Pavement, shall apply except for the modification indicated in these specifications.
§503-5

503-3.01 Placement of Reinforcement. No metal reinforcement for concrete pavement will be required.

503-3.02 Joints. No transverse joints will be required except for expansion joints at bridges and culverts whose top slab is at grade, construction joints at paving stops and special joints. When adjacent lanes of pavement are placed separately, the longitudinal joint between the adjacent slabs shall not be sawed.

503-3.03 Finishing. No hand finishing of the pavement will be required except to correct surface irregularities.

503-3.04 Testing the Surface. Any surface irregularity of the concrete found, when testing the concrete surface prior to initial set, exceeding 10 mm in 3 meters shall be immediately corrected.

503-3.05 Texturing. The surface of the concrete shall be roughened by transverse brooming as directed by the Engineer.

503-3.06 Curing. Curing the portland cement concrete foundation for pavement by the impervious membrane method will not be permitted.

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

503-3.08 Sealing Joints. No joint sealing will be required except in the event that a delay occurs in paving the final pavement course or the final pavement is not laid until the subsequent season. The material used to seal the joints and the method for applying the joint sealer shall be approved by the Engineer.

503-4 METHOD OF MEASUREMENT. The quantity of cement concrete foundation for pavement to be paid for will be the number of cubic meters of concrete computed in accordance with the payment lines shown on the plans. No deductions shall be made for catch basins, manholes, etc.

503-5 BASIS OF PAYMENT. The unit price bid per cubic meter shall include the cost of providing all labor, materials and equipment necessary to satisfactorily complete the work including joint sealer, when used, except that longitudinal tie bars and transverse joint support assemblies will be paid for under their respective items.

When the Contractor elects to substitute an optional concrete class as permitted by Table 501-1, Concrete Class Options, payment will be made for the originally specified class of concrete.

Payment will be made under:

<table>
<thead>
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<th>Item No.</th>
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SECTION 504 THRU 549 (VACANT)