SECTION 501
PORTLAND CEMENT
CONCRETE PAVEMENT

501.01 DESCRIPTION
This work is the construction of PCCP on a prepared subgrade or base course.

501.02 MATERIALS

501.02.1 Concrete
Furnish concrete in accordance with Section 551 for Class Pave concrete.

A. Cement.
Furnish Type I, II, V, IS, IP, or IT portland cement listed on the QPL, in accordance with Subsection 551.02.1.

B. Aggregate.
Use optimized gradations unless otherwise specified. Furnish aggregate in accordance with Subsection 701.01.2 having a wear factor not exceeding 30%.

501.02.2 Reinforcing Steel
Steel-wire fabric and steel bar mat sizes and dimensions are specified in the contract.
Furnish steel-wire fabric reinforcement in flat sheets.
Furnish bar mats and bars of structural or intermediate grade, as specified in the contract.
Furnish all reinforcing steel in accordance with Section 555 and Subsection 711.01.

501.02.3 Dowel Bars and Sleeves
Furnish Grade 40 or 60 plain round dowel bars in accordance with AASHTO M 31.
Epoxy coat the dowel bars in accordance with AASHTO M 254 at 10 ±2 mils. Ensure the bars are coated by an applicator plant listed on the QPL and certified under the CRSI epoxy coating plant certification program for fusion-bonded epoxy applicator plants.
Do not use bars having burrs or other deformation that restrict slipping in the concrete.
Provide dowels with a factory applied petroleum, paraffin-based lubricant with a manufacturer certified use as a bond breaker.
Furnish sleeves for dowel bars meeting the contract requirements.

501.02.4 Tie Bars
Furnish Grade 40 or 60 deformed steel bars in accordance with AASHTO M 31 and Subsection 711.01.2. The length, size, and spacing of the bars are specified in the contract.

501.02.5 Expansion Joint Filler and Joint Sealing Material
Furnish expansion joint filler and joint sealing material listed on the QPL and in accordance with Subsection 707.01.

501.02.6 Curing Compound
Furnish Type 2 curing compound listed on the Department’s QPL and in accordance with Subsection 717.01.3.
501.03 CONSTRUCTION REQUIREMENTS

501.03.1 Equipment

A. General. Do not begin paving operations until all equipment and tools for the pavement construction are available at the site.

Use handling, batching, mixing, and concrete transporting equipment in accordance with Section 551 and the following.

Use batch plants that proportion aggregates and cement by weight using automatic and interlocked proportioning devices. For placements up to 1000 square yards, approval may be requested to use manual plants.

Use hauling equipment in accordance with Subsection 551.03.4. Remove and dispose of concrete remaining in haul units before reloading with fresh concrete. If using non-agitating hauling equipment, ensure smooth, mortar-tight metal bodies that completely discharge the concrete at a uniform rate without segregation. Provide covers when necessary to prevent the concrete from drying out or being exposed to weather-related moisture. Plant-mixed concrete may be transported in non-agitating vehicles provided that concrete is in a workable condition when placed and:

1. Discharge is completed within 45 minutes after the introduction of mixing water to the cement and aggregates, or
2. Discharge is completed within 60 minutes after the introduction of mixing water to the cement and aggregates, provided the concrete mix temperature is 70°F or below during placement, or
3. Discharge is completed within 60 minutes after the introduction of mixing water to the cement and aggregates, provided the mix contains an approved set retarder used in accordance with subsection 551.03.3.

B. Slip-Form Paver. Use a self-propelled slip-form paver capable of consolidating, screeding, and float-finishing freshly placed concrete in one complete pass of the machine for the required thickness. Use machines equipped to internally vibrate the concrete for the full width and depth placed in a single pass as required to produce a dense, homogeneous pavement. Ensure the rate of vibration of each vibrating unit is at least 7,500 cycles per minute. Ensure the vibration is sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least 1-foot. Vary the frequency or amplitude of vibration proportionately with the rate of travel to result in a uniform density and air content. Ensure the paving machine is equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.

Ensure equipment can produce the frequency and amplitude the paver manufacturer recommends for the placement at hand.

C. Stationary Side Forms. Use clean, straight, un-warped steel forms with a vertical face of appropriate for the depth of placement. Ensure that forms have side and base supports capable of supporting finishing equipment and are sufficiently strong to resist concrete pressure without bulging.

Wood or plastic forms for forming fillets, widened areas in intersections, curves less than 100-foot radius, and in other engineer-approved locations.

D. Finishing Equipment for Stationary Side Forms,

2. **Truss Screeds.** Use air-vibrated or mechanically-vibrated truss screeds designed for and capable of striking off the placement.

E. **Joint Sawing Equipment.** Provide wet-cut saws for joint establishment in the all concrete.
   When using early-entry saws, use saw blades and skid plates specifically designed for the type coarse aggregate used in the concrete in accordance with the saw manufacturer’s recommendation.

F. **Hand Finishing Tools.** Use aluminum, magnesium, or wooden hand finishing tools. Do not use steel had finishing tools.

501.03.2 Pre-paving Conference
   Schedule a pre-paving conference to be held at least 72 hours before paving starts.
   Submit an agenda to include equipment, construction methods, specification requirements, and lines of communication.
   The conference must include the foreman, subcontractors/suppliers, other Contractor personnel that will supervise the concrete paving operations, and key Department inspection personnel.

501.03.6 Mixing
   Mix concrete in accordance with Subsection 551.03.3.

501.03.7 Transporting Concrete
   Transport concrete in equipment in accordance with Subsections 501.03.1 and 551.03.4.

501.03.8 Placing and Finishing Concrete
   Concrete will be tested and accepted in accordance with Section 551.

   A. **Slip-form Method.** Uniformly distribute concrete into final position by a self-propelled slip-form paver without delay. Regulate the alignment and elevation of the paver from outside reference lines established for this purpose, or by an electronic control system capable of controlling the line and grade within required tolerances. Ensure the paver vibrates the concrete for the full width and depth of the strip of pavement being placed and the vibration is adequate to provide a consistency of concrete that stands normal to the surface with sharp well-defined edges. Ensure the sliding forms are rigidly held together laterally to prevent spreading.
      Ensure the plastic concrete is effectively consolidated by internal vibration with transverse vibrating units for the full width of pavement and/or a series of equally spaced longitudinal vibrating units. The space from the outer edge of the pavement to the outer longitudinal unit must not exceed 9 inches. The spacing of internal units must be uniform and not exceed 18 inches.
      The term internal vibration means vibration by vibrating units located within the specified thickness of pavement section.
      Hold the concrete at a uniform consistency. Operate the slip-form paver with as nearly a continuous forward movement as possible. Coordinate all operations of mixing, delivering, and spreading concrete to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. Do not apply tractive force to the machine, except that which is controlled from the machine.

   B. **Slip-form Pavers.**
   Have at least 3 staking points for each 10 feet (3 m) of length that securely lock to the form stake; and
   Have a base width greater than or equal to the depth; and
   Have at least 3 staking points for each 10 feet (3 m) of length that securely lock to the form stake.
   Not have horizontal joints; and
   Have a base width greater than or equal to the depth.
   Do not use steel had finishing tools.
When concrete is being placed adjacent to an existing pavement, equip that part of the equipment which is supported on the existing pavement with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

**B. Stationary Side Form Method.** Before placing side forms, ensure the underlying material is at the proper grade. Side forms shall be placed to the required grade and alignment of the edge of the finished pavement. Wood wedges may be used to adjust the form elevation provided they do not extend into the concrete. The forms shall be firmly supported during the entire operation of placing, compacting, and finishing the pavement.

Drill forms in advance of being placed to line and grade to accommodate tie bars where these are specified.

Ensure side forms remain in place at least 12 hours after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Apply curing compound to the concrete immediately after the forms are removed.

Thoroughly clean and oil side forms each time they are used and before concrete is placed against them.

Spread, screed, shape, and consolidate concrete by one or more self-propelled machines. Ensure these machines uniformly distribute and consolidate concrete without segregation so that completed pavement will conform to required cross section with a minimum of handwork.

Ensure the number and capacity of machines furnished is adequate to perform the work required at a rate equal to that of concrete delivery.

Effectively consolidate concrete for the full paving width by means of surface vibrators, in combination with internal vibrators, or by some other method of consolidation that produces equivalent results without segregation.

When vibrators are used to consolidate concrete, ensure the rate of vibration is at least 3,500 cycles per minute for surface vibrators and is at least 7,000 cycles per minute for internal vibrators. Ensure the amplitude of vibration is sufficient to be perceptible on the surface of the concrete more than 1-foot from the vibrating element. Furnish a suitable device for measuring and indicating frequency of vibration. Connect power to vibrators so that vibration ceases when forward or backward motion of the machine is stopped.

**C. Final Surface Finish.** Hand-float the surface only as needed to produce a uniform surface and sharp corners. Adding finishing water to unfinished concrete is prohibited. Do not use excess mortar to build up slab edges or round the slab corners. Before the concrete’s initial set, work the pavement edges along each side of transverse isolation joints, transverse construction joints, and fixed forms to produce a ¼-inch (6 mm) continuous radius and a smooth, dense mortar finish. Check the surface of the concrete for any lack of uniformity of the mortar bond, and fill low areas to the finish elevation with an approved method. Apply additional hand vibration at construction joints as required for concrete of narrow dimensions and to finish any formed joints, transverse construction joints, and emergency construction joints to the required radius. Construct a well-defined, smooth, dense mortar finish.

Hand finishing is permitted only for finishing sections with narrow irregular dimensions and to finish any concrete already deposited on the grade so that a machinery breakdown occur.

Grind high spots exceeding ¼-inch (6 mm) with an approved method. Fill low spots exceeding ¼-inch (6 mm) with an approved epoxy-bonded grout as directed.

**D. Texturing.** Longitudinally tine all pavements unless transverse tining is allowed as described below. In advance of curing operations, where longitudinal tining is required, complete initial and final texturing on the paving. Perform initial texturing with a burlap...
drag or broom device that produces striations parallel with the centerline. Perform final texturing with a wire comb tine device that produces grooves parallel with the centerline. Operate the wire comb tine device within 5 inches, but not closer than 3 inches, of pavement edges.

Ensure burlap drags, brooms, and tine devices are installed on self-propelled equipment having external alignment control. Ensure the area of burlap in contact with the pavement surface is always constant. Include positive elevation control on broom and tine devices. Maintain downward pressure on pavement surface during texturing to achieve uniform texturing without measurable variations in pavement profile. Maintain constant travel speed during texturing. Ensure the wire comb of the final texturing device is rectangular in cross section, 3/32 to 1/8-inch wide, on ¾-inch centers, ± 1/8-inch, and of sufficient length, thickness, and resilience to form grooves approximately 1/8-inch deep in the fresh concrete surface. Ensure final texture is uniform in appearance with substantially all the grooves having a depth between 1/16 and 3/16-inch.

On projects requiring less than 1,000 square yards of cement concrete pavement, for irregular areas or areas not accessible to slip-form pavers, the surface finish may be either longitudinal tined or transverse tined. Complete transverse tining by texturing with a wire comb perpendicular to the centerline. Ensure the wire comb of the final texturing device is rectangular in cross section, 3/32 to 1/8-inch wide, on ¾-inch centers, ± 1/8-inch, and of sufficient length, thickness, and resilience to form grooves approximately 1/8-inch deep in the fresh concrete surface. Ensure final texture is uniform in appearance with substantially all the grooves having a depth between 1/16 and 3/16-inch. Ensure the elements of the wire comb as nearly perpendicular to the concrete surface as is practical, to eliminate dragging the mortar.

Regardless of the surface finish, if the pavement has a raised curb end the texturing 2 feet from the curb line.

501.03.9 Protection of Concrete from Adverse Weather
Maintain materials at the project site to protect all un-hardened concrete surfaces from rain, hail, or snow.

When adverse weather appears imminent, stop paving operations and cover all surfaces of the un-hardened concrete with the protective covering. Do not finish rainwater, hail, or snow into the concrete surface.

501.03.10 Evaluation and Repair of Weather-damaged Concrete
Cease operation when rain is threatening. Remove, replace, or repair any pavement damaged by rain, hail, or snow as determined by the Project Manager. Pavement is considered damaged when rain, hail, or snow leaves noticeable texture on the surface.

All protective, remedial, and corrective work to produce acceptable pavement is at Contractor expense.

501.03.11 Curing
Immediately after finishing operations have been completed and marring of the concrete will not occur, cure the entire surface of the newly placed concrete in accordance with 551.03.7 and one of the following methods.

A. Membrane. Before application, agitate the curing compound as received in the shipping container to obtain a homogenous mixture. Protect membrane curing compounds from

Deleted: After surface finishing, texture all concrete surfaces within the travel lanes. Use either hand operated or mechanical tools to produce a uniform texture that conforms to the dimensions shown in the contract.

For artificial carpet and burlap drag, furnish carpet or burlap that is long and wide enough to cover the entire pavement width and that produces a uniform texture. Clean drag periodically to remove encrusted mortar or replace with new burlap or carpet.

Meet an average surface texture of 0.040 to 0.060-inch (1 - 1.5 mm), as measured by ASTM E965 (sand patch test).

If repair of high spots or low spots results in surface texture loss, repair the affected area to the specified texture at the Contractor’s expense.

1. Design Speed Greater than 50 MPH (80 km/h).
   Produce the final surface finish with transverse tining, followed by longitudinal artificial carpet or burlap drag.
   Space transverse tines randomly as follows:
   Minimum spacing ½-inch (13 mm);
   Maximum spacing 1½-inch (38 mm); and
   No more than 50% of the tines apart by more than 1-inch (25mm).
   Use tines that are ⅛-inch (3 mm) wide, with a tolerance of ± 0.02 inch (± 0.5 mm) and apply them to a depth of ¼ to ½-inch (6 - 12 mm) (provided minimum dislodging of the aggregate particles result).

2. Design Speed Less than 50 MPH (80 km/h).
   Produce the final surface finish by broom texturing, followed by a longitudinal artificial carpet or burlap drag.
   Produce a uniform texture with corrugations ⅛-inch (1.5 mm) deep.
freezing. Handle and apply the membrane curing compound in accordance with the manufacturer’s recommendations and the following:

1. Apply compound to the entire area of the exposed surface of the concrete with an approved mechanical spray machine at a rate of one gallon to not more than 150-square feet.

2. Apply curing compound homogeneously to provide a uniform, solid, white opaque coverage on all exposed concrete surfaces (equal to a white sheet of typing paper) at the time of application.

3. Immediately re-apply compound to damaged areas protected for less than 72 hours by spraying.

4. If the Project Manager determines that the initial or corrective spraying result in unsatisfactory curing, the Project Manager may require the Contractor to use the White Polyethylene Sheeting method, at no additional cost to the Department. Use a fully automatic, self-propelled mechanical power sprayer to apply the curing compound in accordance with the following:

   1. Operate the equipment to direct the curing compound to the surface from two different lateral directions.
   2. Do not allow the sprayer to ride on the pavement surface.
   3. Ensure the sprayer covers the entire lane width and atomizes the curing compound.
   4. If puddling, dripping, or non-uniform application occurs, suspend the operation to perform corrections as approved by the Project Manager.
   5. Ensure the sprayer is equipped with the following:
      a. A re-circulating bypass system that provides for continuous agitation of the reservoir material,
      b. Separate filters for the hose and nozzle,
      c. Check valve nozzles,
      d. Multiple or adjustable nozzle system that provides for variable spray patterns,
      e. A shield to control loss of material by wind action, and
      f. A spray-bar drive system that operates independently of the wheels or track drive system.

   For pavements less than 1000 square yards and for irregular or narrow surfaces, submit a curing plan to the Project Manager for approval including equipment proposed for use.

   Do not apply curing compound to the inside faces of joints to be sealed.

   Do not apply curing compound during rain. Have sufficient material on the project to immediately suspend membrane curing and begin polyethylene sheeting in accordance with 501.03.11(B). Cover all concrete previously placed that is subject to damage or loss of curing compound. Repair all concrete damaged by rain to the Project Manager's approval and at no cost to the Department.

B. White Polyethylene Sheeting. Furnish sheeting in accordance with Subsection 717.01.5. Place sheeting over the pavement immediately after finishing operations are completed.

   Place the sheeting so that individual sheets cover the entire pavement width and overlap longitudinally a minimum of 2 feet. Ensure the lapped areas are held in close contact with the pavement by weighting sufficiently to prevent movement by the wind. Extend the sheeting downward to cover the edges of the pavement and secure to the

Deleted: After the concrete is finished and the free water has left the surface, seal the entire surface area by machine spraying a uniform application of curing compound in accordance with Subsection 501.02.6.

Deleted: Apply the curing compound following the manufacturer’s recommendations before surface hair checking develops.

If the groove coverage is not complete after the first application, apply a second coverage in the opposite direction from the first. Apply the second application within 30 minutes of the first application. Ensure the equipment controls the curing compound application rate and uniformity. Use the coverage rate of 1 gallon per 150 square feet (0.27 L/m²) or follow the manufacturer’s recommendations.

Re-apply membrane curing compound to areas protected for less than 72 hours and that are damaged by sawing, rain, or other causes.

Deleted: Other Methods
501.03.12 Handling and Placing Reinforcement

Keep reinforcing steel clean, rust free, straight and distortion free, placed and held in position as specified. Store reinforcing steel out of the weather, distributing only the steel needed for immediate placing within the work. Assemble and place reinforcement for bar mats as specified. Maintain bar mat placement during concreting operations. Tie all intersections. Lap all adjacent ends at least 40 bar diameters.

501.03.13 Joints

Make transverse construction joints as detailed in the contract, at the end of each day's run, or where concrete work is interrupted for more than 1 hour.

A. Sawing Joints. Saw joints in a single cutting operation for a specific joint. Make saw cuts true to line and to the dimensions shown in the contract. Begin joint sawing as soon as the concrete has hardened sufficiently to permit sawing without raveling or moving of aggregate. Saw joints before uncontrolled cracking takes place. Control joints may be sawed by any saw designed for concrete sawing. If necessary, use continuous sawing operations regardless of weather or daylight conditions. Discontinue sawing a joint if a crack develops ahead of the saw.

A heavy span saw which is supported on the new pavement is not allowed for sawing pavements and concrete overlays less than 7 inches thick. If the pavement has been covered or protected due to cold weather, rain, or snow, saw joints by conventional saw equipment only.

Saw joints requiring compression sealant materials to be installed so that the compression sealant material can be installed and function correctly. Repair uncontrolled cracking or random transverse cracking at no additional cost to the Department. Use repair methods approved by the Project Manager.

B. Expansion Joints. Install preformed joint material perpendicular to the pavement surface. Ensure that the joint material remains in proper position. Set reference stakes or markers showing joint location prior to placing concrete adjacent to the joint. After the mechanical finishing equipment has passed over the joint, check the joint for movement. If movement in excess of ½-inch has occurred, immediately correct the installation to its intended position. After the surface finishing has been completed, edge the joint as shown in the contract documents with minimum disturbance to the adjacent concrete.

C. Sealing Joints. Seal joints as designated in the contract before any portion of the pavement is opened to the traffic, including construction traffic. Saw or prepare joint openings to the designated dimensions. Clean the joint opening and seal with material in accordance with Subsection 501.02.5.

Within 3 hours after a joint has been wet sawed to the finished dimension, flush the wet sawing residue away from the sawed faces using a high-pressure water blast operating with at least 1000 pounds per square inch. Within 3 hours after the joint has

subgrade. Cover any holes or exposed concrete immediately. Maintain the sheeting against injury and ensure complete coverage until the pavement has reached a minimum compressive strength of 2,500 psi.

C. Water Cure. Water cure in accordance with Subsection 551.03.7(A) until the pavement has reached a minimum compressive strength of 2,500 psi.
Longitudinal Joints

501.03.14 Surface Test

Test all other surfaces in accordance with Subsection 501.03.14(B).

D. Alternative Joint Layout.

Submit an alternate plan for longitudinal and transverse joint layout with details that are determined by Contractor to the Project Manager for approval a minimum of 15 business days before the start of paving work. space the transverse joints not less than 10 feet (3.0 m) and not more than 15 feet (4.5 m). Space longitudinal joints not further than 13 feet (3.96 m) and as close to lane lines as possible. Skew longitudinal lines along mainline to match lane lines ahead. Construct transverse joints at a 90° angle to the centerline. Continue transverse joints through the curb. Skew transverse and longitudinal joints to intersect all manholes, boxes, and inlet. The angle of joint intersection or between joints and a free edge must not be less than 60°. Space joint offsets not less than 18 inches (455 mm).

501.03.14 Surface Test

Test pavement surfaces in accordance with the following criteria using the straightedge method.

- Sections less than 300 feet (91.5 m) in length.
- Sections within 50 feet (15.2 m) of existing pavements or bridge ends.
- Sections within 50 feet (15.2 m) of intersections requiring warping to match side streets.
- Sections having horizontal curves with a centerline radius less than 1000 feet (305 m) and the superelevation transitions of those curves.
- Sections having vertical curves with L/A (K-value) less than 100 where L is the length of the curve in feet and A is the grade change in percent (L/A less than 30.5 where L is in meters).

Test all other surfaces in accordance with Subsection 501.03.14(B).
A. **Straightedge.** Measure surface smoothness of travel lanes not subject to MRI testing with a 10-foot straightedge. Ensure the completed surface of the wearing course does not vary more than 1/8-inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the centerline.

Measure smoothness perpendicular to the centerline with a 10-foot straightedge across all lanes with the same cross slope, including shoulders when composed of cement concrete pavement. Discontinue the overlapping 10-foot straightedge measurement at a point 6 inches from the most extreme outside edge of the finished pavement. Ensure the completed surface of the wearing course does not vary more than 1/4-inch from the lower edge of a 10-foot straightedge placed on the surface perpendicular to the centerline. Correct any deviations in excess of the above tolerances.

Where the grinding methods would result in an unsatisfactory surface or in a slab thickness less than specified, the affected pavement may require an adjustment in the contract unit price or removal and replacement in accordance with Subsection 501.03.20.

B. **Ride Specification.** Pavement surface smoothness for this project includes International Roughness Index (IRI) testing. Perform IRI testing on each through lane, climbing lane, ramp, and passing lane, greater than 0.2 mile in length. These sections will be subject to incentive/disincentive adjustments. Evaluate ride quality using the Mean Roughness Index (MRI) calculated by averaging the IRI data for the left and right wheel path within the section.

Shoulders, tapers, and other areas not included in MRI testing will not be subject to incentive adjustments. All work is subject to parallel and transverse 10-foot straightedge requirements, corrective work and disincentive adjustments.

Operate the inertial profiler in accordance with AASHTO R 57. Collect two longitudinal traces, one in each wheel path. Collect profile data after completion of all concrete paving on the project in a continuous pass including areas excluded from pay adjustments. Provide notice to the Project Manager at least 7 calendar days prior to testing.

Within 30 calendar days after the Contractor’s testing, the Department may perform verification testing. If the verification testing shows a difference in MRI greater than the percentages shown in Table 2 of AASHTO R 54 the following resolution process will be followed:

1. The profiles, equipment and procedures will be evaluated to determine the cause of the difference.

2. If the cause of the discrepancy cannot be resolved, coordinate retesting with both profilers at a mutually agreed upon time. The two profilers will test the section within 30 minutes of each other. If the retest shows a difference in MRI equal or greater than the percentages shown in Table 2 of AASHTO R 54 the Engineer’s test results will be used to establish pay adjustments.

Evaluate profiles for acceptance, incentive payments, disincentive payments, or corrective action using the current version of ProVAL and provide the results including the profile data in unfiltered electronic Engineering Research Division (ERD) file format to the Project Manager within 2 business days of completing testing each section of...
pavement. If the profile data files are created using an export option in the manufacturer's software where filter settings can be specified, use the filter settings that were used to create data files for certification.

Analyze the entire profile. Exclude any areas specifically identified in the Contract. Exclude from the analysis the first 50 feet after the start of the paving operations and last 50 feet prior to the end of the paving operation, the first 50 feet on either side of bridge structures and bridge approach slab. Report the MRI results in inches per mile for each 52.8 foot section and horizontal distance measurements in project stationing to the nearest foot. Include pay adjustments in the results. The Project Manager will verify the analysis.

Corrective work for pavement smoothness may be taken by the Contractor prior to MRI testing. After completion of the MRI testing, measure the smoothness of each 52.8-foot section with an MRI greater than 125 inches per mile with a 10-foot straightedge within 14 calendar days or as allowed by the Project Manager. Identify all locations that require corrective work and provide the straight edge measurements at each location that exceeds the allowable limit to the Project Manager. If all measurements in a 52.8-foot section comply with smoothness requirements, provide the maximum measurement to the Project Manager and a statement that corrective work is not required. Corrective work is required for pavement identified by the Contractor or Department that does not meet the following requirements:

1. The completed surface is uniform in texture, smooth, uniform as to crown and grade, and free from defects of all kinds.
2. The completed surface does not vary more than ¼ inch from the lower edge of a 10-foot straightedge placed on the surface parallel to the centerline.
3. The completed surface does not vary more than ⅛ inch in 10 feet from the rate of transverse slope shown in the contract.

Correct areas to demonstrate that the segment is acceptable.†

Complete all corrective work at no additional expense to the Department, including traffic control. Do not begin corrective work until the concrete has reached design strength. Repair pavement by one or more of the following methods:

1. Diamond grinding; ensure repairs do not reduce pavement thickness by more than ¼ inch less than the thickness shown in the contract. When required by the Project Manager, verify the thickness of the concrete pavement by coring. Thickness reduction due to corrective work will not be included in thickness measurements for calculating the Thickness Deficiency in Subsection 501.03.20.
2. Removal and replacement.
3. By other method allowed by the Project Manager.

Delete:: Furnish a 25-foot (7.6 m) wheel base California type profilograph and a competent operator to measure the surface smoothness before joint sealing. Do not exceed a maximum 3 mph (4.8 km/h) operational speed. Calibrate, adjust, and operate the profilograph following the manufacturer’s instructions and California Test Method 526.¶

Provide the Project Manager 24 hours advance notice before using the profilograph. The Project Manager will witness all profilograph recordings. The profilograph must record a scale of 1-inch to 25 feet (25 mm to 7.6 m) longitudinally and 1-inch to 1-inch (25 mm to 25 mm) vertically. Take a profile on a line parallel to and 3 feet (0.9 m) inside the outside edges of each traffic lane. Run the profilograph parallel to the pavement edge at all times. Additional profiles may be taken to define the limits of an out-of-tolerance surface. The Project Manager will determine the profile index using California Test Method 526.¶

Calculate an average profile index in 0.1-mile (161 m) lane segments, and segments greater than 300 feet (91 m) with no adjacent lanes. If a segment less than 0.1 mile (161 m) remains for a lane, that segment will be combined with the adjacent segment for an average profile index.¶

Perform corrective work when the lane average profile index exceeds the value specified in Table 501-1. Remove all high points in excess of 0.3-inch (8 mm) in 25 feet (7.5 m) or less using a method approved by the Project Manager. Re-profile corrected areas to demonstrate that the segment is acceptable.¶

Use the following definitions for Category 1 and Category 2 surfaces. Category 1 surfaces are through lanes with a speed limit of 45 mph or greater. Category 2 surfaces include ramps, acceleration lanes, turn lanes, and all other lanes not meeting the criteria of Category 1. Lane segments containing both Category 1 and Category 2 criteria will be evaluated as Category 2.¶

Contract unit price adjustments are made following Table 501-1. The Contractor may elect to perform corrective work to reduce the average profile index when it is less than the corrective index but greater than the incentive index. Incentive will not be paid on sections with an initial index requiring corrective work.¶

TABLE 501-1¶

| CONTRACT UNIT PRICE ADJUSTMENT¶ |

English
mm) using an approved grooving machine. Use a vertical rotary-cutting machine that can follow the crack path and widen the top of the crack to the required section without spalling or damaging the concrete. Remove all loose and fractured concrete, and thoroughly clean and seal the groove with the sealant specified in the contract.

The Project Manager will determine what random cracks are tight, don’t penetrate the full depth of the pavement and will be left undisturbed. When requested by the Project Manager, determine the crack depth penetration by drilling and inspecting cores at Contractor expense.

When a transverse random crack terminates in or crosses a transverse contraction joint, fill the un-cracked portion of the joint with epoxy-resin mortar or grout, and route and seal the crack.

When a transverse random crack nearly parallels the planned contraction joint and is within 5 feet (1.5 m) from a contraction joint, route, seal, and fill the crack with epoxy-resin grout or mortar.

When a transverse random crack is more than 5 feet (1.5 m) from the nearest contraction joint in the pavement, seal both the joint and the crack. Thoroughly clean the joints before filling with epoxy-resin mortar or grout.

Repair spalls by making a saw cut at least 1-inch (25 mm) outside the spalled area and to a minimum depth of 2 inches (50 mm). When the spalled area abuts a joint, make a saw-cut 2 inches (50 mm) deep or ⅔ the slab thickness, whichever is greater. Chip out the concrete between the saw cut and the joint or primary crack to solid concrete. Thoroughly clean the resulting cavity of all loose material. Apply a prime coat of epoxy-resin binder to the dry, cleaned surface of all cavity sides, except the working joint faces to be retained. Apply the prime coat by scrubbing it into the surface with a stiff bristle brush. Place hydraulic cement concrete or epoxy-resin concrete or mortar immediately following the prime coat application.

For spalled areas abutting working joints or working cracks penetrating full depth, place an insert or other bond breaker to maintain the joint or crack during the patch repair.

501.03.16 Opening to Traffic

Do not permit traffic or Contractor equipment, excluding joint sawing and sealing equipment, on the concrete until one of the following test results indicate the concrete has developed sufficient strength.

A. **Flex Beam Method.** Prepare the concrete flex beams in accordance with MT 101 and test for modulus of rupture using AASHTO T 97.

One test set consists of 3 beams. Take the concrete for the test beams from different concrete batches for each 2,500 square yards (2,100 m²) of concrete pavement and make at least 2 sets per day. Test the beam sets for modulus of rupture. Cure the test beams under the same environmental conditions as the pavement they represent. The pavement, represented by the beams, may be opened to traffic when the average modulus of rupture of the set exceeds 350 psi (2,415 kPa) and no individual beam's modulus of rupture is less than 300 psi (2,070 kPa).

The Contractor may select the time for testing the beams. Test the flex beams on or near the project, using Contractor furnished equipment and with a Department Inspector witnessing the tests.

Include all costs to make, cure and test the flex beams in the contract unit price for PCCP.

B. **Maturity Meter Method.** Prepare concrete flex beams or compressive test cylinders to validate the maturity meter performance curves. Furnish the Project Manager the
maturity-strength relationship and maturity curves along with supporting data for verification. Maturity-strength relationship must indicate compressive strengths of 2500 psi or greater. Develop the maturity meter index curves before construction has commenced.

Determine the time for testing flex beams. Furnish suitable testing equipment.

The pavement may be opened to traffic and construction equipment, with Project Manager’s approval, when the maturity meter readings reflect target values have been met.

Furnish all equipment, including maturity meter, thermocouples, wire, and a qualified technician to monitor the maturity meter system.

C. Concrete Test Cylinder Method. Prepare concrete test cylinders according to MT 101 and AASHTO R 60, and test for compressive strength according to AASHTO T 22.

Make a minimum of one set of three compressive test cylinders, sampled from random locations, for each 2,500 square yards (square meters) of concrete pavement but not less than two sets per day. Test compressive test cylinders in sets of three for compressive strength. Cure test cylinders under the same conditions as the pavement they represent.

The pavement may be opened to traffic and construction equipment, with Project Manager’s approval, when the average compressive strength of a set of test cylinders is 2500 psi (17,237 kPa) or greater with no single test less than 2,000 psi (13,790 kPa).

Determine the time for testing cylinders. Furnish suitable equipment and test compressive cylinders on or near the project.

Opening to traffic does not constitute a final acceptance of the pavement. The pavement is accepted upon confirmation of the 28-day flexural strength. Repair all concrete damaged prior to the final acceptance at Contractor expense.

501.03.17 Integral Curb

Construct the curb monolithically with the pavement.

Construct the inside face of the curb true to the lines and grades in the contract using the finish specified for the concrete pavement, including longitudinal floating and burlap drag finishing.

Test the surface for longitudinal trueness with a straightedge while the concrete is still plastic. Meet the same surface requirements specified for the concrete pavement.

Continue concrete pavement joints through the integral curb at the same locations, of the same type, and constructed in the same manner.

Cure the integral curb as specified for concrete pavement.

501.03.18 Weather and Night Limitations

Place concrete at night only with the Project Manager’s written approval.

Stop concrete work when the ambient temperature falls below 40 °F (4 °C) and do not resume until the ambient air temperature reaches 35 °F (2 °C) and is rising.

Do not place concrete on a frozen foundation course or subgrade.

Remove and replace all concrete damaged by frost at Contractor expense.

501.03.19 Protection of Concrete

Cover the concrete with an approved commercial insulating blanket, covering all pavement if the ambient temperature falls below 35 °F (2 °C) during the cure period. Leave in place for 7 days.
The Project Manager may direct the leaving the blanketing in place beyond the 7-day curing period.

501.03.20 Pavement Thickness

Construct concrete pavement to the specified thickness. Pavement not meeting the required thickness will be subject to replacement in accordance with Subsection 501.03.20(B) or to the price adjustments according to Table 501-2. Tolerances allowed for subgrade or base course construction do not modify the thickness requirements.

A primary unit of pavement is the pavement area placed in each day's paving operations. Within each primary unit there may be several secondary units as specified in 501.03.20(B)(2).

A. Thickness Verification.
1. **Survey Method.** Thickness measurement locations will be determined by random sampling in accordance with MT 606. A minimum of 10 random locations will be tested for each 12,000 square feet (1,115 m²) of pavement placed within the primary unit. Elevations will be recorded to the nearest 0.01-foot (3 mm). Measurements will be taken as follows:
   - The locations will be selected on the finished surface before paving and at the same location on the finished concrete surface.
   - The thickness variation will be determined by subtracting the planned thickness from the constructed thickness at each surveyed location. Variations exceeding the planned thickness will be considered as a 0.00 feet (0.0 mm) deviation in the average. The average of the measurements will represent the variation for that primary unit.

2. **Coring Method.** The Project Manager reserves the right to verify the thickness or resolve discrepancies by coring using AASHTO T 148, recording that measurement to the nearest 0.01-foot (3 mm). Fill core holes with concrete of the same quality as used for the pavement at no cost to the Department.

B. Thickness Deficiency.
1. **Variation less than or equal to 0.07-foot (21 mm).** If the thickness variation in a primary unit is less than 0.07-foot (21 mm), a deduction will be applied in the amount determined in Table 501-2 times the area of pavement in the primary unit. No incentive or contract adjustment will be allowed for constructed thicknesses exceeding the planned thickness.

**TABLE 501-2**

<table>
<thead>
<tr>
<th>Pavement Greater Than 5 Inches (127 mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Thickness Deficiency</strong></td>
</tr>
<tr>
<td>Feet</td>
</tr>
<tr>
<td>0.02</td>
</tr>
<tr>
<td>0.03</td>
</tr>
<tr>
<td>0.04</td>
</tr>
<tr>
<td>0.06</td>
</tr>
<tr>
<td>0.07</td>
</tr>
</tbody>
</table>
Average thickness deficiencies greater than 0.02-foot (6 mm) are rounded to the nearest 0.01-foot (3 mm) and the deficiency adjustment made using Table 501-2.

2. Variation greater than 0.07-foot (21 mm). For each section in a primary unit with a thickness variation greater than 0.07-foot (21 mm), the Project Manager will determine the dimensions of the secondary unit area. The secondary unit is made up of entire panels only. Panels are the areas bound by longitudinal and transverse joints and pavement edges.

C. Acceptance. The Project Manager will randomly measure the thickness in each panel adjacent to the panel(s) in the primary unit which exceeded 0.07-foot (21 mm), by either the survey method or AASHTO T 148. Measurements are taken in each panel until the panels which exceed 0.07-foot (21 mm) are isolated. The Project Manager will determine which panel(s) will require replacement and which may remain in place when the limits of the secondary unit have been defined. Acceptance will be in accordance with procedures (a) or (b) below:

a. Remove and replace the deficient panels at Contractor expense with new concrete. If the area to be removed is not bounded by longitudinal or transverse joints, saw the weakened plane joints at Contractor expense at the locations designated by the Project Manager. Lower the subgrade or base to meet the full thickness requirements. Replaced pavement will be tested for thickness requirements using additional secondary measurements and is subject to all of the contract requirements.

b. The Contractor may leave deficient pavement panels in place if the panels meet all of the other contract requirements. A deduct equal to 50% of the contract unit price per square yard (m²) will be imposed for those pavement panels left in place. The Department may deduct that amount from any monies due or that may become due the Contractor in accordance with the contract. The decision to leave a deficient panel in place will be by contract modification in accordance with Subsection 105.03. The cost of all secondary thickness measurements made under this subsection will be deducted from any monies due or that may become due the Contractor in accordance with the contract.

After isolating the secondary unit area(s) from consideration, the average thickness deficiency of the remainder of the primary unit areas will be determined in accordance with Subsection 501.03.20(B)(2). Secondary measurements made outside of a secondary unit area will be used to determine an average in the remaining primary unit area in which the measurements are taken.

No contract adjustment will be allowed for meeting these requirements.

501.03.21 Accelerated Paving Techniques
Submit a request with details for any proposed accelerated paving techniques to the Project Manager a minimum of 7 calendar days before use. Accelerated paving techniques may include but are not limited to; admixtures, cement, alternative curing methods, sawing methods, and joint sealing.

501.04 METHOD OF MEASUREMENT
Furnishing and installing all tie bars, dowels, setting and maintaining wire control lines, sawing longitudinal and transverse joints, sealant, reinforcing steel, accelerated paving
techniques, and testing for opening to traffic is not measured for payment. Include all costs in the unit price of PCCP.

501.04.1 Area Measurement

PCCP is measured by the square yard (m²).

The measured width is from outside to outside of completed pavement including integral curb, not exceeding the specified width or the width ordered by the Project Manager.

The length is measured along the centerline of the pavement surface.

Fillets for widened sections or at drainage structures and similar locations placed monolithic with the pavement are measured as pavement.

Areas constructed other than as pavement are deducted from the pavement area. No deduction is made for any fixture located within the pavement limits that has a surface area in the plane of the pavement surface of 1 square yard (0.80 m²) or less.

Integral curb included in the completed pavement is not measured separately for payment.

501.05 BASIS OF PAYMENT

Payment for the completed and accepted quantities is made under the following:

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement Concrete Pavement</td>
<td>Square Yard (m²)</td>
</tr>
</tbody>
</table>

Payment at the contract unit price is full compensation for resources necessary to complete the item of work in accordance with the contract.

REASON: Rewrite/Modernize

COMMENTS:

NOT FINALIZED