

## PART VI—RIGID PAVEMENT

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## Section 601 Portland Cement Concrete Pavement

**601.01 DESCRIPTION.** Construct Portland Cement Concrete Pavement (PCCP) on a prepared subgrade or base course in accordance with these specifications and as shown on the plans.

Definition: Fresh concrete is being in a plastic state that has not achieved initial set.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled Application of Quality Assurance Specifications for Portland Cement Concrete Pavement and Structures.

**601.02 MATERIALS.** Provide materials as specified in the following sections and subsections.

Portland Cement Concrete	901, 1001
Aggregates	1003
Joint Materials	1005
Reinforcing Steel	1009.01
Dowel Bars	1009.03
Curing Materials	1011.01
Epoxy Resin Systems	1017
Water	1018.01
Hydrated Lime	1018.02
Non-Shrink Grout	1018.04
Geotextile Fabric	1019

Furnish either Type B or D concrete. Use the same type of concrete throughout the project, unless otherwise authorized in writing.

Account for delayed and fluctuating set times and strength gain characteristics when utilizing supplemental cementitious materials in PCCP.

### **601.03 CONSTRUCTION.**

**601.03.1 Equipment:** Provide and maintain in good mechanical condition all equipment and tools for concrete batching, paving, finishing, and curing operations. Paving and miscellaneous equipment shall comply with the requirements of the appropriate subsection. Submit, at least 7 days prior to paving, a list of the proposed equipment and tools necessary for handling materials and performing the work.

Deliver all equipment to the job site at least 24 hours prior to the start of operations for examination.

**601.03.1.1 Batching Plant and Equipment:** See 901.09 and 901.10.

**601.03.1.2 Mixers:** See 901.10.

**601.03.1.3 Central Plant:** See 901.10.

**601.03.1.4 Truck Mixers and Truck Agitators:** See 901.09 and 901.10.

**601.03.1.5 Non-agitator Trucks:** See 901.09.

**601.03.1.6 Finishing Equipment:** Use slip-form paving equipment or equipment with stationary side forms to construct pavement.

**601.03.1.6.1 Slip-Form Method:** Place concrete with a slip-form paver that can spread, consolidate, screed, and finish the freshly placed concrete in one complete pass. Vibrators for slip form pavers shall be internal type with either immersed tube or multiple spuds and capable of consolidating the concrete for the full width and depth. Ensure that vibrators attached to the spreader or finishing machine, or mounted on a separate carriage, do not touch joints, load transfer devices, the subgrade, or side forms. Vibrate only when paver is in motion. Limit the vibration frequency from 5,000 to 8,000 vibrations per minute.

**601.03.1.6.2 Stationary Side-Form Method:** Use a type of screed sufficiently rigid to retain its shape to finish the surface to the specified typical section. Use wooden or metal screeds for hand finishing or mechanical twin oscillating-type roller or truss-type screeds that are at least two feet longer than the slab width. The contractor may use hand held vibrators for side form concrete placements. Maintain a minimum frequency of 4,500 vibrations per minute for the approved hand-held vibrators.

**601.03.1.7 Concrete Saw:** Provide saws to timely cut joints and backup saws in case of equipment failure.

**601.03.1.8 Forms:** Provide metal, solid, and stable forms having a depth of the specified pavement thickness with a minimum base width of 0.8 of the depth except as otherwise approved. Use flexible or curved forms for curves up to 100-foot radius. Keep forms rigid and stable during paving. Remove forms with battered top surfaces or forms that are bent or broken.

Limit the maximum variance in the top of the form to 1/8 inch in 10 feet from a true plane. Limit the maximum face variance to 3/8 inch in 10 feet. Tightly lock forms together at the ends of abutting form sections and are set securely on the grade.

**601.03.1.8.1 Built-Up Forms:** When approved, built-up forms may be used; however, do not exceed 2 inches of build-up. There is no limitation on the use of built-up forms or amount of build-up where the total area of pavement is less than 2,000 square yards.

**601.03.1.9 Floats:** Machine floats shall be composed of cutting and smoothing floats suspended from, and guided by, a rigid frame constantly in contact with side forms. Long handled floats shall have blades at least 5 feet long and 6 inches wide.

**601.03.1.10 Straightedge:** Use a minimum 10-foot metal static straightedge with handles approximately 3 feet longer than the paving width.

**601.03.1.11 Artificial Turf Drag:** The artificial turf shall be made of molded polyethylene with synthetic turf blades approximately 0.85 inch long containing approximately 7,200 individual blades per square foot. The artificial turf carpet shall be full pavement width and of sufficient size that during the finishing operation it produces 1/16 inch deep striations in the pavement surface. For pavement 16 feet or more in width, mount the artificial turf on a bridge that travels on the forms that allows control of the time and rate of texturing. If necessary, weigh the carpet to maintain intimate contact with the pavement surface.

**601.03.1.12 Burlap Drag:** The burlap drag shall consist of a seamless strip of damp burlap that shall produce uniform 1/16 inch deep striations in the pavement surface after dragging it longitudinally along the full width of the pavement. For pavement widths 16 feet or more, mount the drag on a bridge that travels on the forms that allows control of the time and rate of texturing.

**601.03.1.13 Tine Texturing Device:** The tine-texturing device shall have metal tines that produce randomly spaced grooves uniform in appearance and transverse to roadway. Tine dimensions and spacing requirements shall be in accordance with 601.03.9.8. The pavement shall have a continuously tine textured surface.

**601.03.2 Mixing Limitations:** Ensure adequate natural or artificial light when mixing, placing, or finishing concrete. See 105.20.

Abide by specified temperature limitations for mixing, placing, finishing, and curing. See 901.11.1 and 901.11.2.

**601.03.3 Conditioning Subgrade or Base Course:** Correct deficient areas in subgrade or base courses. Clean the subgrade or base course of loose material and maintain the finished subgrade in a smooth, compact, satisfactory condition. Restore disturbed areas prior to placing the pavement in accordance with 301.14. Correct all deficient areas at no direct pay.

Keep the subgrade and base course uniformly moist when placing concrete, unless specifications require a waterproof cover material.

**601.03.3.1 Asphalt Concrete Base Course for PCCP:** Wet the asphalt surface to minimize early-age cracking. At the time of concrete placement, ensure the surface is moist with no standing water.

Alternatively, apply a mixture to the asphalt concrete base course to prevent heat buildup in the base and bonding between the concrete pavement and base. If the

contractor elects to use a whitewash mixture, use mixtures consisting of hydrated lime and water or a wax-based white-pigmented curing compound. The whitewash mixture used and application rate shall be the responsibility of the contractor. The mixture proposed by the contractor will be subject to Department approval.

**601.03.4 Preparing the Proper Grade:** Trim, fill, and thoroughly compact all irregularities below the established grade with subgrade or base course material for a minimum width of 16 inches on both sides of the base of the form. Tamp or trim above-grade defects or variations to plan elevation. Maintain the finished grade in a smooth and compacted condition until placement of pavement. The Department must approve the subgrade or base course before placement of concrete.

**601.03.5 Setting Forms:** Ensure that the foundation under forms is firm, provides stable continuous contact, and is true to line and grade. The Project Engineer may allow shims up to 1/2 inch, not to exceed 20 percent per individual form section.

Form sections shall be tightly locked and free from movement in any direction. No settlement or springing of forms under the paving equipment is acceptable. At a minimum, place a pin at each side of every form joint. Pins shall be of sufficient length to provide adequate anchorage. Limit the maximum variance of the top form to 1/8 inch in 10 feet from a true plane. Limit the maximum face variance to 3/8 inch in 10 feet.

**601.03.6 Placing and Consolidating Concrete:** Deposit concrete on a surface-moist base or subgrade with a minimum of handling. Base course must be less than 120°F immediately prior to concrete placement. Place concrete continuously between transverse joints. Use appropriate tools for necessary hand spreading. Place concrete as close to joints as possible without disturbing them. Ensure workers wear footwear clean of foreign matter.

Except for concrete sawing equipment, restrict operation of mechanical equipment on the pavement until obtaining a minimum compressive strength of 3,000 psi in accordance with DOTD TR-230.

Pave adjacent lanes only after a minimum elapse of 1-day with no observable marring of the surface.

Rain protection along with hot and cold weather limitations of 901.11 shall apply.

Complete the surface finish as specified in 601.03.9.7. Texture the surface as specified in 601.03.9.8.

Cure the surface and edges as specified in 601.03.10.

**601.03.6.1 Slip-Form Method:** At the option of the contractor, the slip-form paving method may be used.

Place concrete with an acceptable slip-form paver designed to spread, consolidate, screed and float finish freshly placed concrete in one pass of the machine with only a minimum amount of hand finishing necessary to provide a

dense, homogeneous pavement in conformance with plans and specifications. Equip the machine with vibrators conforming to 601.03.1.6.1. Vibrate concrete for the full pavement width and depth for complete consolidation. Hold sliding forms rigidly together laterally to prevent spreading of forms.

Provide concrete of a uniform consistency exhibiting minimal bleed water and laitance. Operate the slip-form paver with as nearly a continuous uniform forward movement as possible. Coordinate mixing, delivering and placing of concrete to provide uniform progress. Concrete plants shall have sufficient mixing capacity to provide such continuous delivery of concrete to enable the paver to advance at a minimum rate of 1.5 feet per minute. If it is necessary to stop forward movement of the paver, also immediately stop the vibrator and tamping elements. If forward movement of the paver is delayed for a period, the engineer may direct fogging of fresh concrete. See 601.03.8 for construction joint requirements. Apply no outside tractive force to the machine except as controlled from the machine.

**601.03.6.2 Stationary Side-Form Method:** Deposit concrete as near as possible to forms and joints assemblies without disturbing the form or joint assembly.

Use vibrators to consolidate concrete against and along the faces of all forms and the length and both sides of all joint assemblies. Limit vibrator operation to 5 seconds in any one location.

**601.03.7 Test Specimens:** According to DOTD sampling and testing procedures, furnish concrete for casting test specimens and all required tests at no direct pay.

**601.03.8 Joints, Seals, and Sealants:** Saw and seal the joints according to Standard Plans CP-01.

Before preparation and sealing, verify each joint for proper width, depth, alignment.

Prior to sealing, the pavement may be opened to traffic. When poured or extruded sealants are used, allow the concrete to cure at least 7 days prior to sealing joints.

Thoroughly clean all joints immediately prior to sealing. Use sandblasting followed by an oil-free air jet to clean the faces and joint openings before sealing. Use poured or extruded sealants for sealing.

Cured sealant is required before allowing traffic on pavement. When using a poured or extruded sealant in accordance with 1005.02, close the pavement to traffic for at least one day after sealing. When elastomeric compression seals are used, allow traffic immediately following completion of sealing.

Repair any cracking, chipping, spalling, or tearing of the concrete joints at no direct pay by approved methods to the satisfaction of the engineer.

Before sealing, joints shall be free of spalls, fractures, breaks, or voids. For areas requiring minor repairs, chip back to sound concrete and repair with an approved

non-shrinking patching system in accordance with the manufacturer's recommendations, when approved by the engineer.

**601.03.8.1 Poured Sealants and Preformed Joint Sealers:** The following additional requirements apply to the installation of poured sealants and preformed joint sealants complying with 1005.02, 1005.03, and 1005.06.

**601.03.8.2 Hot Poured Rubberized Asphalt Sealants:**

**601.03.8.2.1 Joint Preparation:** Thoroughly clean joints by sandblasting to remove concrete curing membrane, laitance and other foreign matter from the joint. Upon completion of sandblasting, clean and dry the joint and adjacent areas of all foreign matter.

**601.03.8.2.2 Application:** Install poured sealants complying with 1005.02.1 in accordance with the following requirements.

Do not install the sealant until joint verification for cleanliness, dimensions, and alignment. Seal the joint without formation of entrapped air or voids. Air temperature at the time of installation shall be at least 50°F and rising.

Furnish a mobile, heated, double-walled agitator type kettle with suitable oil medium in the outer space for heat transfer capable of maintaining a sealant temperature of 380°F to 410°F. Provide easy access to kettles to facilitate cleaning. Thoroughly clean kettles of foreign substances or previously used compounds and flush daily with flushing oil. Provide this equipment with an automatic continuous temperature-recording chart for constant kettle temperature surveillance. Provide a direct connecting pressure type-extruding device with nozzles shaped for insertion into the joint. Application equipment shall recirculate sealant material in the inner kettle when not in use and shall be capable of filling the joint with sealant material free of voids or entrapped air. The applicator shall be subject to approval.

**601.03.8.3 Preformed Elastomeric Compression Seals:** Preformed elastomeric compression seals shall comply with 1005.03. When using a pumped adhesive-lubricant material, allow a maximum of 30 percent dilution with a material recommended by the manufacturer. Apply the adhesive lubricant just prior to installation of the seal and completely cover the seal's sidewalls.

Install seals by machine on projects requiring 3,000 feet or more of joint sealing. Do not stretch the compression seal more than 5 percent. Prior to beginning installation, cut and install, a length of seal equal to the pavement width so that stretching may be measured. Make random checks for stretching as deemed necessary by the engineer. If the adhesive lubricant has chemically set and exceeded maximum stretch limits, remove and clean the seal, re-clean the joint, and re-install the seal. There shall be no field splicing.

**601.03.8.4 Silicone Sealant:** The silicone sealant shall comply with 1005.02.3 or 1005.02.4. Keep the sandblasted joint faces dry and dust free prior to sealant installation. The air temperature at the time of placement shall be at least

50°F and rising. Place backer material complying with 1005.02 as shown in the plans. Prime the joint faces in accordance with the manufacturer's recommendations when a silicone sealant conforming to 1005.02.4 is used.

Force non-sag material against the joint walls by approved tooling methods that will ensure proper adhesion. No tooling is required when a self-leveling material is used.

**601.03.8.5 Preformed Polyurethane Foam:** Preformed polyurethane foam shall comply with 1005.06. Install preformed polyurethane foam using an approved, moisture insensitive lubricant-adhesive according to the manufacturer's instructions.

**601.03.8.6 Tie Bars:** For size, length, and spacing of tie bars see Standard Plans CP-01.

Place tie bars using mechanical equipment or secure them with chairs to prevent movement during concrete placement. Place tie bars perpendicular to the face of the joint, centered in the slab depth, and parallel to the finished surface. Do not place tie bars within 18 inches of contraction or expansion joints.

Do not coat tie bars with asphalt or other material or enclose in tubes or sleeves. Bend only Grade 40 tie bars at right angles against the form of the first lane constructed and straighten into final position before placement of concrete in adjacent lane. Alternatively, to bending tie bars, use approved mechanical butt splicing devices complying with 806.06.

Replace tie bars that break or show evidence of fracture upon straightening. Drill holes for tie bars approximately 1/8 inch larger than the diameter of the bar. Holes shall be clean and moisture free. Use an Approved Materials List adhesive anchor system in accordance with the manufacturer's recommendations.

**601.03.8.7 Dowel Bars:** Dowel bars shall have a uniformly round cross section and shall be saw-cut, smooth, and free of burrs, projections, and deformations. Dowel bars shall be plastic coated in accordance with 1009.03.

Place dowel bars in approved basket assemblies or by an approved mechanical device that is capable of accurately placing the dowels to the proper depth and alignment. Position dowel bars parallel to the pavement centerline, and parallel to the surface without any skew of individual bars.

Carefully and thoroughly consolidate the concrete around the dowel bars. When using a mechanical insertion device for placement, firmly hold dowel bars in position during the consolidation process so that the bars do not move when released in the concrete by the mechanical insertion device.

Accurately and securely, mark the transverse centerline of the in-place dowel bars prior to sawing the transverse contraction joint over the dowels.

Provide an approved expansion tube on each bar used in expansion joints. The tube shall fit the dowel bar tightly and the closed end shall be watertight. Locate dowel bar placement as shown on the plans.

With the approval of the engineer, repair all slightly damaged coatings of dowel bars by lightly oiling or greasing; otherwise replace.

#### **601.03.8.8 Types of Joints:**

**601.03.8.8.1 Longitudinal Joint (Type LJ):** Construct a longitudinal joint between the slabs when placing shoulder and roadway pavement slabs separately. Construct a longitudinal joint in roadway pavements placed monolithically and exceeding 15 feet in total width as shown on plans. Construct a longitudinal joint at the centerline of ramps exceeding 15 feet in width. Construct longitudinal joints with tie bars when constructing adjacent lanes separately. Ensure proper consolidation of concrete adjacent to longitudinal joints. Repair or replace any cracking, chipping, spalling, or tearing of the concrete at no direct pay by approved methods to the satisfaction of the engineer.

Form the longitudinal joint (Type LJ) in fresh concrete. Alternatively, saw hardened concrete as soon as the concrete has reached sufficient strength to support the sawing machine, and tearing and raveling of the concrete joint does not occur. Complete the sawing operation in a timely manner such that random cracking does not occur.

The joint width shall be 5/32 to 1/4 inches; joint depth shall be as specified on the plans. The joint sealant shall conform to 1005.02.1 or 1005.02.3.

Immediately prior to sealing, clean the saw cut and adjacent concrete surfaces.

Do not permit any equipment, other than the sawing machine, on the pavement during sawing operations. Provide sufficient back-up equipment at the jobsite to continue timely sawing operations in case of a breakdown.

During paving operations, clearly and accurately mark joint locations. When sawing operations are not providing proper crack control at the joint, modify sawing operations as necessary to provide proper crack control.

**601.03.8.8.2 Transverse Expansion Joint (Type EJ-1 1/2 Inch):** When a slip form paving method is used, construct the transverse expansion joint with a 1 1/2 inch wide sawed joint over a sleeper slab. Construct the sleeper slab from Class A1 Concrete or one of the pavement type mixes complying with Section 901. Place one layer of tarpaper equivalent to a minimum of 30 pounds per 100 square feet between the sleeper slab and the pavement. If the EJ modified joint is used, construct all the expansion joints using this method unless otherwise approved by the engineer.

**601.03.8.8.3 Transverse Expansion Joint (Type EJ-4 Inch):** This joint consists of a 4-inch wide joint sawed over a sleeper slab. Construct the sleeper slab from Class A1 concrete, or one of the pavement type mixes conforming to

Section 901. Place one layer of tarpaper, weighing 30 pounds per 100 square feet, between the sleeper slab and the pavement. Joint material shall comply with 1005.06.

**601.03.8.8.4 Transverse Expansion Joints (Type EJ-Alternative):** Replace concrete disturbed during expansion joint installation with fresh concrete and vibrate with a surface vibrator. Use a preformed elastomeric compression seal complying with 1005.03 or a silicone complying with 1005.02.

**601.03.8.8.5 Wood Filler:** Use wood filler conforming to 1005.01.2. Do not use a board less than six feet long. Do not use damaged wood fillers. Do not field modify wood filler.

Use dowel bars to provide adequate bracing to hold the wood filler in a vertical position. Do not permit finished joints to deviate more than 1/4 inch in horizontal alignment from a straight line. For joint fillers assembled in sections, do not allow offsets between adjacent units. Do not permit plugs of concrete within the expansion space. Seal the joint as specified.

**601.03.8.8.6 Transverse Contraction Joints (Type TCJ):** Transverse contraction joints shall consist of planes of weakness created in the cross section of the pavement. Install load transfer devices at these joints. Construct joints for pavement with a design speed equal to or greater than 45 mph) by sawing as specified in method 1 below. Construct by any of the following methods for joints for pavement with a design speed of less than 45 mph. For small and irregular areas, the engineer may allow methods 2 or 3.

Method 1: Construct joints by sawing after the concrete has reached sufficient strength to support sawing equipment. During paving operations, clearly and accurately mark joint locations. Saw joints to required joint width and depth in one pass. Saw to a width 5/32 to 1/4 inches and to the required joint depth. If forms prohibit sawing the transverse contraction joint for the full width of pavement, place a full-joint depth insert in the 6 inches adjacent to the forms. Conduct the sawing as soon as the concrete has hardened sufficiently to avoid tearing of the concrete and complete sawing in a timely manner to avoid random cracking.

Immediately prior to sealing joint, clean the saw cut as required.

Do not permit any equipment other than the sawing machine on the pavement during sawing operations. Provide sufficient back up equipment at the jobsite to continue timely sawing operations.

If sawing operations are not providing proper crack control, modify sawing operations, equipment, timing, and/or concrete mix as necessary to provide proper crack control.

Repair any cracking, chipping, spalling, or tearing of the concrete joints at no direct pay by approved methods to the satisfaction of the engineer.

Method 2: Install an approved removable joint former to create a joint to the required width and depth. Establish a vertical plane prior to installing the removable joint former in the fresh concrete with a T-iron. The blade of the T-iron shall have a thickness of 1/4 to 3/8 inch and a depth 1/4 inch greater than the depth of the insert. Insert the joint former in place and consolidate using a vibrating bullfloat. While concrete is workable but stiff enough to maintain joint opening, raise joint former 1/2 inch to 3/4 inch with all laitance removed alongside of insert. The joint former shall remain in place at least 12 hours. If undamaged in removal and clean of foreign material, these joint formers are reusable. Immediately prior to sealing joint, clean the joint as required.

Method 3: Install a combination joint former/sealer device as specified in 1005.04 to form a joint in fresh concrete. Establish a vertical plane prior to installing the seal insert device in the fresh concrete with a T-iron. The blade of the T-iron shall have a thickness of 1/4 to 3/8 inch and a depth 1/4 inch greater than the depth of the insert. Insert the joint former/sealer in place and consolidate using a vibrating bullfloat. The top cap of the insert shall be flush with the top surface of the pavement at the completion of all finishing operations.

#### **601.03.8.8.7 Transverse Construction Joints (Type CJ):**

Construct transverse construction joints when there is an interruption of more than 1/2 hour in concreting operations. Do not construct a transverse construction joint within 5 feet of an expansion or contraction joint. If sufficient concrete is not available at the time of interruption to form a slab at least 5 feet long, remove concrete back to the preceding working joint (which must be maintained) or 5 feet behind the working joint to establish a non-working joint. Use hand vibrators to ensure proper consolidation of concrete adjacent to transverse construction joints. Transverse construction joints shall include deformed bars conforming to the size, spacing, and dimensions of the dowel bars to form a non-working joint.

**601.03.8.8.8 Longitudinal Butt Joint (Type LBJ):** Construct longitudinal butt joints when adding lanes of pavement. Place deformed tie bars of the specified length, size, spacing, and material perpendicular to longitudinal butt joints. Do not coat tie bars with asphalt or other material or enclose in tubes or sleeves.

Install tie bars in clean, moisture-free holes, drilled into the existing pavement approximately 1/8 inch larger than the diameter of the tie bar. Use an Approved Materials List adhesive anchor system, or an Approved Materials List Type I, Grade C epoxy resin system.

Mix the epoxy in accordance with the manufacturer's recommendations, with no fillers or extenders added. Using a caulking gun or other approved method, inject sufficient epoxy to fill the void between the tie-bar and hole. Rotate the bar while inserting to ensure complete coverage with no voids as verified by epoxy squeezing

out when the bar is inserted. Prevent bars from being disturbed until epoxy has sufficiently cured. Place epoxy using manufacturer's temperature limitations but do not apply epoxy when ambient temperature is below 40°F.

**601.03.8.8.9 Transverse Butt Joint (Type BJ):** Construct transverse butt joints when extending existing pavement. Place smooth dowel bars of the specified length, size, coating, spacing, and material perpendicular to transverse butt joints.

Install dowel bars in clean, moisture-free holes, drilled into the existing pavement approximately 1/8 inch larger than the diameter of the dowel bar. Use an Approved Materials List adhesive anchor system, or an Approved Materials List Type I, Grade C epoxy resin system.

Mix the epoxy in accordance with the manufacturer's recommendations, with no fillers or extenders added. Using a caulking gun or other approved method, inject sufficient epoxy to fill the void between the dowel bar and hole. Rotate the bar while inserting to ensure complete coverage with no voids as verified by epoxy squeezing out when the bar is inserted. Prevent bars from being disturbed until epoxy has sufficiently cured. Place epoxy using manufacturer's temperature limitations but do not apply epoxy when ambient temperature is below 40°F.

Establish joint sealant reservoir in accordance with plan details (See CP-01).

**601.03.9 Concrete Paving:** The normal sequence for paving is strike-off, consolidation, screeding, floating (use hand floats only if necessary), remove laitance, straight edging, final surface finish, and curing. Use a mechanically powered finishing machine capable of spreading, consolidating, screeding and finishing the concrete to the required pavement elevation and cross section. Mechanical roller or truss-type screeds are allowed, if approved by the engineer, for projects with: concrete pavement lane lengths of 1,500 feet or less, continuous paving lengths less than 600 feet, pavement gaps, intersections, or when side clearance is restricted.

Use work bridges or other devices to reach the pavement surface to finish, straightedge, and make corrections.

If permitted by the engineer, apply water to the surface as a fog spray with approved equipment.

**601.03.9.1 Strike-Off:** Strike off to achieve the specified cross section and pavement surface elevation.

**601.03.9.2 Consolidation:** Consolidate concrete for full width and depth of the slab to eliminate voids without segregation. Consolidate under and around load transfer devices, and other features embedded within the pavement without causing damage or misalignment. Do not operate vibrators longer than 10 seconds in one location. Do not drag handheld vibrators through the concrete nor move the concrete using the vibrator.

**601.03.9.3 Screeding:** Screed the concrete to achieve the specified cross section and elevation.

**601.03.9.4 Floating:** Float to achieve the specified grade and provide a tight-knit textured surface using an approved machine float.

When necessary following machine floating, use long-handled floats to smooth and fill open-textured pavement areas. Hand finish with bull floats only where the surface left from the paving equipment contains voids or imperfections. In general, it is best to limit hand and mechanical finishing. Adjust the concrete mixture and/or the paving equipment if excessive floating is the only method to produce an acceptable tight-knit textured surface.

Remove excess water or laitance from the pavement surface.

**601.03.9.5 Straight Edging:** Test the fresh concrete surface for trueness with a straightedge to achieve surface tolerance. Immediately fill depressions with freshly mixed concrete, strike off, and refinish. Trim and refinish high areas. Ensure the surface across joints meets the requirements for smoothness. Continue straightedge testing and surface corrections until the entire surface is free from deviations and the slab conforms to required grade and cross section. Make adjustments if continuous hand corrections are required.

**601.03.9.6 Edging at Forms and Joints:** Before tine texturing, work the edges on each side of the pavement and each side of the transverse expansion joints, Type EJ modified joints, and longitudinal construction joints, which are not sawed. Produce a well-defined, continuous radius and obtain a smooth, dense mortar finish with an approved tool. Round to the radius specified (1/4 inch approximate). Use a work bridge to work the joints. Do not disturb the pavement surface by tilting the tool during use.

Eliminate tool marks on the slab adjacent to joints without disturbing the rounding of the slab. Remove concrete on top of joint filler.

**601.03.9.7 Final Surface Finish:** Perform surface finishing with an artificial turf or burlap drag such that the resultant pavement surface is uniform in appearance and reasonably free from grooves over 1/16 inch deep. Provide an adjacent concrete shoulder with the same finish as the pavement. Keep the drag material free of hardened concrete. Replace drag materials that are dirty, exhibit wear, or produce unsatisfactory results.

**601.03.9.8 Transverse Tine Texturing:** Operate the metal tine-texturing device by approved mechanical means when texturing roadway travel lanes. If approved, the contractor may use manual methods for tine texturing of ramps, crossovers, turnouts, split slab construction or other pavement sections. Tine texturing will not be required on parking areas, drives, or other areas as designated by the engineer. Rake tines shall be steel flat wire approximately 0.025 inches thick by 0.126 inches wide by 4 to 5 inches in length, randomly spaced, at a maximum

spacing of 1 1/2 inch and a minimum spacing of 3/8 inch with no more than 50 percent of the spaces exceeding 1 inch . The width of tines shall be 1/8 ± 1/64 inch. The depth of groove produced in the concrete shall be 3/16 inch maximum and 1/16 inch minimum, measured in accordance with DOTD TR 229.

Provide the same finish on the adjacent concrete shoulders as the travel lane. Visually inspect the tine texture on the shoulders.

Correct all pavements not meeting the above requirements by retining if concrete is still fresh or by mechanical grooving if the concrete has set. Restore the texture to specified depth, width, and spacing.

**601.03.10 Curing:** Immediately after completing the surface finishing, uniformly spray all exposed pavement surfaces with white pigmented curing compound as soon as surface bleed water evaporates, or within one-half hour if evaporation occurs quickly. Apply curing compound to exposed edges without spraying any exposed tie bars. Do not apply curing compound during rainfall or to surfaces with standing water. Maintain curing continuously for 72 hours.

Apply curing compound under pressure by mechanical sprayers at the rate recommended by the manufacturer, but in no case less than 1 gallon per 100 square feet of surface area. Use the fully atomizing type of spraying equipment with a tank agitator. Immediately prior to and during application thoroughly mix the compound, stirring continuously by mechanical methods.

Hand spraying is allowed on small irregular widths or shapes and on surfaces exposed by form removal. Thoroughly agitate the curing compound prior to placing in the sprayer.

After application of curing compound, resulting pavement surfaces shall have a uniform appearance of a “blank white sheet of paper.” Immediately reapply additional compound to all deficient areas during the curing period.

**601.03.11 Surface Tolerance (IRI):**

**601.03.11.1 General:** This subsection outlines the measurement of surface roughness, quality control requirements, corrective actions, and acceptance criteria for PCCP. Use the International Roughness Index (IRI) to determine the amount of roughness in a measured longitudinal profile. In the direction of travel, measure the longitudinal surface profile in inches per mile and report as the IRI; all in accordance with DOTD TR 644.

**601.03.11.2 Equipment:** In accordance with TR 644, furnish a DOTD certified inertial profiler for quality control and acceptance testing. The inertial profiler shall measure both wheel paths simultaneously with laser height sensing equipment at a constant speed within the certified range. Due to the surface texture of PCCP, lasers with a footprint greater than a single point are recommended for accurate readings. Profilers require a current DOTD decal indicating the date of certification and the profiler’s system parameter settings.

Furnish a 10-foot metal static straightedge for quality control and acceptance testing for transverse cross slope, grade, and individual longitudinal bumps in excess of 1/4 inch in 10 feet. Additionally, bumps are not to exceed 1/4 inch in 10 feet for non-IRI pavements including but not limited to bike paths, detour roads, parking areas, sidewalks, turning lanes, turn outs, and shoulders.

### **601.03.11.3 Quality Control;**

**601.03.11.3.1 Longitudinal Smoothness:** Run the certified profiler and evaluate the raw IRI data using the ProVAL “25-foot sliding baseline” to identify areas of localized roughness as defined by Table 601-2 for each wheelpath. Correct deficiencies in accordance with Table 601-2 and modify construction operations to mitigate deficiencies.

Any individual bump, which is more than 1/4 inch when tested with a 10-foot metal static straightedge, is a deficiency, which requires correction.

Have quality control IRI results available for assessment by the engineer as requested.

**601.03.11.3.2 Correction of Deficient Areas:** Correct areas to meet the requirements of Table 601-2 and the 1/4 inch in 10 feet straight edge bump requirement. Correct transverse, cross slope, or grade deficiencies to meet specifications. Make corrections by removing and replacing the PCCP full depth, or by diamond grinding and reestablishing surface texture and depth. Make corrections at no direct pay.

In cases involving minor dips and extreme vertical curves where grinding will not improve the surface profile, provide the engineer a justification plus a ProVAL screen shot for the area showing the 25-foot sliding baseline and corresponding 25-foot profilograph along with a request to accept as constructed.

Although omitted from corrective action, these areas still contribute to the overall IRI results.

### **601.03.11.4 Acceptance:**

**601.03.11.4.1 Longitudinal Surface Tolerance Acceptance:** Measure the mainline continuously from start to finish in the direction of travel for each lane for the project’s entire length. Perform the measurement under the observation and in the presence of the certified DOTD inspector. For projects that qualify for 102 percent pay, in accordance with Table 601-1 and allowable grinding in accordance with Table 601-2, the Materials and Testing Section will verify the testing results. Measure the surface tolerance for acceptance at the completion of the project after all corrective actions.

Profiler system parameter settings shall be verified before and during each run by the DOTD inspector. The inspector will witness and document the daily setup procedure and pre-operation tests performed by the contractor in accordance with the manufacturer’s procedures and DOTD TR 644. A copy of the manufacturer’s

setup, pre-operation, and general operating procedures for measuring surface tolerance, along with a copy of DOTD TR 644, shall be available at all times during measurement. Place a start and stop mark at the beginning and end of each travel lane so that the Department can rerun measurements.

The mainline longitudinal surface tolerance IRI specification requirements are in Table 601-1.

The Department will view the mainline PCCP's IRI raw data with the ProVAL 25-foot sliding base line to identify areas of localized roughness as defined by Table 601-2 for deficiencies. Submit to the engineer for approval the locations and screen shots for any allowed uncorrected deficiencies in accordance with 601.03.11.3.2. Although grinding for some areas may be deemed unnecessary by the engineer the measured roughness for such areas will still contribute to the total IRI for the project. In addition, the Department will check for 1/4 inch bumps at locations determined by the engineer. Correct deficiencies in accordance with 601.03.11.3.2.

A DOTD inspector will be present for the acceptance testing and will immediately receive a copy of the raw data, the "\*.erd" file and any files with information about the project, the operator, the equipment, the settings, daily pre-operation results, and a copy of the IRI results via USB flash drive. In addition to the data transferred by USB storage device, provide the engineer a paper copy of the IRI report. Acceptance for the project will be in accordance with Tables 601-1 and 601-2. The Department may elect to perform and utilize independent ride quality test results for acceptance at any time.

**601.03.11.4.2 Exclusions:** Take the IRI acceptance measurement in its entirety, without exclusions. The Department will then review the profile report obtained for each lane. In special cases or extenuating circumstances, the engineer may isolate or exclude sections of the profile. These include the following:

- Bridges, including the approach slabs
- Curb and gutter sections, just the affected wheel path, and adjacent areas
- Manholes, catch basins, valve and junction boxes
- Intersections of a different grade
- Structures located in the roadway which cause abrupt deviations in the profile
- Ramps less than 1500 feet
- Sections where the project engineer determines that attaining smoothness is beyond the contractor's reasonable control.

The roughness in excluded areas will not be included in the total IRI used for payment purposes, but shall meet the requirements of 601.03.11.3.2 and Table 601-

2. The quantity represented by the roadway length excluded will not receive any bonus pay adjustment for surface tolerance.

**601.03.12 Removing Forms:** Keep the forms in place for at least 12 hours and until concrete has set sufficiently to avoid damage or prior to opening to traffic as allowed by 601.03.13. Remove forms carefully to avoid damage to pavement. Repair all superficial damage with mortar composed of one part cement and two parts fine aggregates. After removal of forms, immediately cure sides of the slab in accordance with 601.03.10.

**601.03.13 Opening to Traffic:** Allow traffic on the pavement after 14 days or when test specimens, complying with 601.03.7, attain a compressive strength of 3,000 psi when tested in accordance with DOTD TR 230 or a flexural strength of 550 psi when tested in accordance with AASHTO T-97. Saw initial stress relief joints and clean the pavement prior to opening to traffic. If full width joints are cut, seal before opening to traffic.

**601.03.14 Acceptance Requirements:**

**601.03.14.1 General:** Conduct sampling for DOTD testing on each pavement lot for thickness, concrete strength, and surface tolerance. Sample in accordance with the DOTD Sampling Manual. Correct all pavement that is obviously defective, or remove and replace to full depth, to the satisfaction of the engineer. Times and locations will be established by the engineer.

A pavement lot is an identifiable area of approximately 4,000 square yards paid under the same item. The final area of pavement placed is a lot if it is at least 2,000 square yards; otherwise, it will be included in the previous lot. The engineer may redefine the lot limits when sequences of construction prevent timely sampling and testing.

Consider intersections, entrances, crossovers, ramps, and any other identifiable placement as separate lots.

**601.03.14.2 Concrete Strength and Thickness:**

**601.03.14.2.1 Compressive Strength:** Determine the 28-day compressive strength and thickness of pavements from hardened cores. The Department, in accordance with DOTD TR 225, will identify random concrete core locations and determine the diameter, thickness, and strength. Cut the cores in the presence of a DOTD representative. The DOTD representative will take immediate possession of the cores for thickness and strength determinations. Notify the District Laboratory Engineer at least five days prior to the start of coring operations.

The engineer will divide each pavement lot into five equal sections. Obtain one core from each section after meeting surface tolerances. Provide additional cores required by the Department to isolate thickness, strength or other pavement deficiencies, or for recutting of deficient cores at no direct pay. Patch all core holes using an approved pavement or structural concrete mixture meeting the requirements

of Section 901. Patch the core holes immediately after coring operations. Finish the surface of the patch to match the surrounding pavement. Include the cost of patching the core holes in the bid price of the concrete coring.

When the average strength for the lot is less than 4,000 psi, the contract unit price will be adjusted in accordance with Table 601-3. When an individual core indicates compressive strength less than 3,000 psi, remove, and replace the entire deficient section with concrete of the specified quality. If the Chief Engineer determines that the concrete may be left in place, payment for the quantity of concrete represented by the deficient core will be made at 50 percent of the contract unit price. Payment for the remainder of the lot will be made in accordance with Table 601-3 based on the average compressive strength of the remaining sections.

**601.03.14.2.2 Flexural Strength:** The 28-day flexural strength (modulus of rupture) will only be required when specified in the contract documents. Submit a contractor-controlled curing and delivery plan to the engineer for approval.

Determine flexural strength of pavements from 6-inch by 6-inch by 20 inch cast beams. Cast and cure the beams in accordance with TR-226. The Department will randomly determine sample frequency and location for casting beams. Cast and mark the beams for identification in the presence of a DOTD representative. The Department will perform acceptance testing.

**601.03.14.2.3 Thickness:** Construct pavement to plan thickness. Under thickness will be subject to the payment adjustments shown in Table 601-3.

For PCCP requiring compressive strength acceptance, determine thickness from the cores.

For PCCP requiring flexural strength acceptance, use a 2-inch core to determine thickness. An alternate method may be submitted to the Department for approval.

The engineer, in calculating average pavement thickness, will consider individual measurements in excess of specified thickness by more than 0.25 inch as specified thickness plus 0.25 inch.

Replace with concrete of specified thickness areas deficient in thickness by more than 1 inch. If the Chief Engineer determines the deficient area may remain in place, payment for the quantity of concrete represented by the deficiency will be made at 50 percent of the contract unit price. Payment for the remainder of the lot will be in accordance with Table 601-3 based on the average thickness of the remaining lot segments.

**601.03.14.2.4 Projects with Less Than 2,000 Square Yards of Pavement:** Cored as required in 601.03.14.2.1 and 601.03.14.2.2 above, or may be accepted based on compressive strength cylinders and thickness measurements taken by the engineer.

**601.03.14.3 Surface Tolerance:** Test in accordance with 601.03.11.

**601.03.14.4 Tolerances along Longitudinal Edges:** Check the

pavement edge with a minimum 5-foot straight edge while the concrete is still in a fresh state. Do not allow the surface within a 6-inch width to vary more than 1/4 inch. This tolerance applies to those locations where subsequent paving (additional lanes, shoulders, turnouts, ramps, widening, curb and gutters, etc.) is to be constructed adjacent to the placed pavement. Correct any edge slump settlement before the concrete has hardened. Place fixed side forms at the slab edges when correcting deficiencies. If continuously unable to meet tolerance, cease paving operations and take corrective action.

For edges where there will be no adjacent pavement, the tolerance is 1/2 inch in 6 inches.

If unable to correct edge slump deficiencies before the concrete has hardened, correct as follows.

**601.03.14.5 Edges at Longitudinal Joints:** Correct by full depth removal and replacement of the pavement edge with tied concrete. Remove the pavement by full depth sawing for a width necessary to bring the pavement within the required tolerance. The maximum allowable width for removal and replacement with adjacent concrete work is 12 inches.

If the pavement surface corrections require removing more than 12 inches of the pavement edge, remove the pavement full depth for one-half of the lane width. Replace in accordance with the Department's full depth concrete pavement patching details prior to placing the adjacent pavement.

Begin and end all removals at a transverse joint.

**601.03.14.6 Edges not along Longitudinal Joints:** Correct by full depth removal and replacement of the pavement edge with tied concrete for a minimum width of 12 inches and to the original width at proper grade. Begin and end all removals at a transverse joint.

**601.03.15 Quality Control:** The contractor is responsible for all operations including but not limited to the production, transporting, placement, joint construction, surface finishing, maintenance, and curing of all concrete pavement and shoulders constructed in accordance with these specifications. Control the work to produce concrete pavement and shoulders that are uniform and conform to the plan dimensions and test requirements. Perform whatever tests are necessary to ensure the concrete pavement and shoulders comply with these specifications. Use construction methods that prevent cracking.

**601.04 MEASUREMENT.** The quantities for payment will be the design quantities specified in the plans and adjustments thereto. There will be no adjustments in plan quantities unless the engineer makes changes to adjust to field conditions, plan errors, or if design changes are necessary.

**601.05 PAYMENT.** Payment will be on a lot basis at the contract unit price per square yard, which includes furnishing and placing all materials including tie bars, dowel bars, and joint material. Payment for concrete cores taken for thickness and strength acceptance is at the contract unit price per each as described in 601.03.14.2. There will be no adjustment in the unit price for coring when there are different pavement-thicknesses specified. If the pavement does not comply with acceptance requirements, adjust unit price payments in accordance with Table 601-3. If there are payment adjustments for more than one deficiency, they are cumulative. Payment for surface tolerance (IRI) will be in accordance with 601.03.11. Grinding is not allowed to achieve incentive payment beyond meeting Table 601-2 requirements. Progressive partial payments for PCCP are at 100 percent with all IRI bonus and penalty assessments at final acceptance.

Payment will be made under:

<b>Item No.</b>	<b>Pay Item</b>	<b>Pay Unit</b>
601-01	Portland Cement Concrete Pavement ____ in. Thick	Square Yard
601-02	Portland Cement Concrete Pavement (Crossovers and Turnouts)	Square Yard
601-03	Portland Cement Concrete Shoulder ____ in. Thick	Square Yard
601-04	Portland Cement Concrete Coring	Each

**Table 601-1<sup>1</sup>**  
**Pavement Adjustment Schedule for Mainline Longitudinal Surface Tolerance, Maximum International Roughness Index, inches per mile**

Percent of Contract Unit Price		102% <sup>2</sup>	100%	98%	50% or Remove and Replace <sup>3</sup>
Category I: Design Speed ≥60 mph	IRI in/mi	≤65	≤75	76-84	≥85
Category II: Design Speed ≥45 mph and <60 mph	IRI in/mi	≤75	≤85	86-94	≥95
Category III: Design Speed <45 mph	IRI in/mi	N/A	≤115	116-129	≥130

<sup>1</sup>Applies to each travel lane for the entire project's length.

<sup>2</sup>Incentive Pay Requirements:

Must equal or be less than the average IRI indicated for bonus payment.

Grinding is not allowed to achieve incentive payment but requirements for 601.03.11.3.2 must be met.

<sup>3</sup>At the option of the Chief Engineer.

**Table 601-2<sup>1</sup>**  
**Individual Wheel Path**  
**Deficient Area Boundaries Requiring Corrective Action**  
**Maximum International Roughness Index,**  
**inches per mile**  
**as measured to nearest whole number**

Any 25-foot Sliding Baseline		PCCP: Longitudinal Direction
Category I	IRI in/mi	≤170
Category II	IRI in/mi	≤190
Category III	IRI in/mi	≤210

<sup>1</sup>The contractor shall use a continuous 25-foot sliding base selected in the ProVal software to analyze and determine must grind areas of localized roughness as specified by this table. The limits for localized roughness, unless greater than that shown in the table above, must be identified and corrected, or accepted by the Project Engineer.

**Table 601-3**  
**Payment Adjustment Schedule**

	Payment (Percent of Contract Unit Price/Lot) <sup>1</sup>			
	100	95	80	50 or Remove and Replace <sup>2</sup>
Deficiency in Average Thickness of 5 cores/lot, inches	0 to 0.13	0.14 to 0.25	0.26 to 0.5	Over 0.50
Average Compressive Strength, psi	≥4000	3500 to 3999	3000 to 3499	Below 3000

<sup>1</sup>Payment adjustment shall be cumulative.

<sup>2</sup>At the option of the Chief Engineer.

## **Section 602 Portland Cement Concrete Pavement Rehabilitation**

**602.01 DESCRIPTION.** Repair and rehabilitate existing, aged portland cement concrete pavements. This work includes pavement grinding and texturing, retrofitting of dowel bars, full and partial depth pavement patching, cleaning and resealing or filling of longitudinal and transverse joints, cleaning and sealing of cracks, and undersealing in accordance with these specifications, plan details, and as directed by the engineer. Section 602 is not applicable to newly constructed portland cement concrete pavement.

Dispose of removed materials, including concrete pavement, outside the project rights-of-way in accordance with 202.02.

Quality assurance requirements shall be as specified in the latest edition of the Department's publication entitled "Application of Quality".

**602.02 MATERIALS.** Materials for concrete pavement rehabilitation shall comply with the requirements of the appropriate subsections. The engineer must approve the materials before performing the work.

**602.03 EQUIPMENT.** Equipment for concrete pavement rehabilitation shall comply with the requirements of the appropriate subsections. The engineer will approve equipment and tools necessary for handling materials and performing the work. The equipment shall be at the job site sufficiently ahead of the start of operations for examination and approval.

**602.04 CLEANING AND FILLING EXISTING LONGITUDINAL PAVEMENT JOINTS ( $\geq$  2 INCH WIDTH).** Remove joint sealants in longitudinal joints, two inches and wider, in existing concrete pavement and fill the joints in accordance with the plans or as directed and as follows. Clean joints and adjacent pavement surfaces of existing sealants, incompressibles and debris to the satisfaction of the engineer in accordance with the plans by sandblasting. Blow the joint dry, free of any debris by compressed air just prior to filling. The air compressor will be equipped with an approved oil and water trap. Dry the joints before filling. Fill prepared joints within 24 hours. Reclean joints that have become contaminated or dirty before filling as directed.

Fill the joints with an epoxy concrete consisting of a mixture of epoxy resin system and thoroughly dry fine aggregate. The epoxy resin system shall be Type I Grade 1 complying with Section 1017. The fine aggregate shall consist of packaged concrete or mortar sand complying with 1003.08.1. Prior to mixing, ensure that the sand is in oven dried condition. The mixture proportions of the epoxy concrete shall be one part epoxy resin system to approximately four parts fine aggregate, by dry volume. The final mix proportions shall be such that during placement the slump of the mixture will allow the material to fill all voids and be consolidated and finished. Mix the epoxy resin system and fine aggregate in equipment and by methods that produce a homogenous mixture.

Place reinforcing steel in the joint as shown on the plans. Cut the reinforcing steel at transverse joints. Establish transverse joints in the epoxy concrete by using inserts or sawing, and then sealing.

Protect existing transverse joints from intrusion of epoxy concrete. If epoxy concrete gets into the transverse joints, immediately clean the joints of epoxy concrete to the satisfaction of the engineer.

The filled joint shall remain closed to traffic until, in the engineer's opinion, the epoxy concrete and joint sealant have satisfactorily cured.

**602.05 CLEANING AND RESEALING EXISTING LONGITUDINAL AND TRANSVERSE PAVEMENT JOINTS.** Remove joint sealants in longitudinal and transverse joints of existing concrete pavement and reseal the joints in accordance with the plans or as directed and as follows. Clean joints and adjacent pavement surfaces of existing sealants, incompressibles, and debris in accordance with the plans to the satisfaction of the engineer. Clean joint faces by sandblasting and blow free of any debris by compressed air just prior to resealing. Make a minimum of one pass with the blasting nozzle held at an angle close to the surface [1-2 inches] along each reservoir face. The air blowing operation is to proceed in one direction (forward) to prevent recontamination of the joint. Equip the air compressor with an approved oil and water trap. Dry the joint before resealing. Reseal prepared joints within 24 hours. Reclean any contaminated joints before sealing, as directed.

Resealing materials shall comply with 1005.02.1. Install resealing materials in accordance with plan details and the manufacturer's recommendations. Use an appropriate sized backer rod material for the joint size complying with 1005.02.1. While sealing joints, seal small crushed corners, not repaired by other methods, with hot poured sealant to the satisfaction of the engineer at no direct pay.

Keep the resealed joint closed to traffic until the sealant has satisfactorily cured to tack free.

**602.06 CLEANING AND SEALING CRACKS.** Clean and seal longitudinal, diagonal, and transverse cracks in accordance with the plans or as directed and as follows. The minimum width of the crack to be sealed shall be 3/8-inch at the pavement surface. The engineer will designate which cracks are to be sealed.

Clean cracks by sandblast or water blast. Route cracks, less than 1/2 inch, to form a sealant reservoir approximately 1/2 inch wide by 1/2 inch deep, and blow free of sand or water by compressed air just prior to sealing. Make a minimum of one pass with the blasting nozzle held at an angle close to the surface [1 - 2 inches] along each reservoir face. Proceed in one direction (forward) with the blowing operation to prevent recontamination of the joint. Equip the air compressor with an approved oil and water trap. Keep the crack dry before sealing. Seal prepared cracks within 24 hours. Reclean any contaminated cracks before sealing, as directed. Seal cracks with a hot poured sealant complying with 1005.02.1, installed in accordance with the manufacturer's recommendations.

Keep the sealed cracks closed to traffic until the hot poured sealant has satisfactorily cured to tack free.

**602.07 FULL DEPTH CORNER PATCHING OF JOINTED CONCRETE PAVEMENT.** Remove and replace to full-depth, portland cement concrete pavement corner breaks at locations shown on the plans or as directed and as follows.

Remove unsound concrete within the patch area. The engineer must approve the method of removal. This approval is subject to demonstrating satisfactory performance without damage to the base course and adjacent pavement structure.

Before placing concrete, saw existing joints, within or adjacent to patch areas, to provide for the placement of fiberboard or other approved material in the joint. Extend the fiberboard for the full thickness of the pavement.

Remove deteriorated base course in the patch area, at no direct pay, and replace with concrete while patching as directed. When the engineer orders additional thickness of patching, in excess of plan thickness, payment will be made for the additional thickness in accordance with 602.17.4.

Place approved wood or metal forms or fiberboard for side forms adjacent to shoulders. A maximum 12 inches width of shoulder surfacing and base may be removed to facilitate forming; however, repair all damage to shoulder underdrain systems, and patch removed shoulder and base areas to the satisfaction of the engineer after form removal at no direct pay.

Clean concrete surfaces within the patch area of loose particles, dust, and debris. Apply a bonding grout to the existing concrete in the patch area with a stiff bristle brush just prior to placement of the new concrete. Grout shall consist of equal parts of portland cement and sand by weight with enough water to provide a stiff slurry. Continuously agitate the grout and use within 90 minutes.

Use Type B, D, or E concrete for pavement patching complying with Section 901. Allowable for use are approved set-accelerating admixtures, complying with 1011.02, at the dosage recommended by the admixture manufacturer. Place, consolidate, finish, and cure the concrete as directed.

Texture the patch surface to match the texture of adjoining pavement. If pavement is to be overlaid, only drag finish the patched surface. The finished patched surface profile shall meet a maximum 1/4 inch deviation using an approved minimum 10-foot metal static straightedge.

Immediately after finishing, apply curing compound at one gallon per 100 square feet that results in the surface looking like a blank sheet of white paper.

Saw and seal transverse joints as shown on the plans. Reestablish the longitudinal joint to match the existing longitudinal joint. Use an appropriately sized backer rod material for the joint size complying with 1005.02.1. Use a sealant complying with 1005.02.1 in accordance with the manufacturer's recommendations. Keep the patches closed to traffic until the sealants have satisfactorily cured.

Keep patches closed to traffic until standard test specimens conforming to the DOTD Materials Sampling Manual and 601.03.7 have attained a compressive strength of 3000 psi when tested in accordance with DOTD TR 230. Cure and transport cylinders to be tested in 24 hours or less in an insulated container without artificial heating until time of testing. Only with the Chief Construction Engineer's approval, can the maturity method be utilized for compressive strength determination.

### **602.08 FULL DEPTH PATCHING OF JOINTED CONCRETE PAVEMENT.**

Remove and replace to full-depth portland cement concrete pavement, with proper joints, at locations shown on the plans or as directed and as follows. Coordinate construction activities to limit lane closures. If pavement has been removed and cannot be replaced during daylight hours, temporarily backfill the areas with aggregate acceptable to the engineer and keep the lane closed to traffic.

Perform saw cutting with a concrete saw for the full depth of the pavement along the perimeter of the pavement as marked by the engineer. Repair spalls in the existing pavement resulting from pavement removal in the patch area by extending the removal limits to include the spalled areas. Make pavement removal for spall repair at the full patch width. Repair of the spalled areas shall be at the contractor's expense. Reduce the pavement to appreciable sized pieces by making additional saw cuts or by using hand held jackhammers or an approved resonant pavement-breaking device to reduce the pavement to pieces. Regardless of method, ensure there is no damage to the existing base course.

Remove the resulting pieces by lifting lugs or other approved methods that will not damage the existing base course or the remaining edges. This approval will be

subject to the contractor demonstrating satisfactory pavement removal without damage to the base course.

Remove deteriorated base course in the patch area and replace with patching concrete or as directed by the engineer.

Remove base course in the patch area damaged by the contractor and replace with concrete as directed at no cost to the Department. When the engineer orders additional thickness of patching in excess of plan thickness, payment for the additional thickness will be made in accordance with 602.17.5.

Drill holes for dowel bars and tie bars into vertical faces of the adjoining pavement, and install bars with an Approved Materials List adhesive anchor system as shown on the plans or as directed. Lightly oil or grease the free end of the dowel bar.

Place approved wood or metal forms for side forms adjacent to shoulders. A maximum 12 inches width of shoulder surfacing and base may be removed to facilitate forming; however, repair all damage to shoulder underdrain systems, and patch removed shoulder and base course areas to the satisfaction of the engineer after form removal at no direct pay.

Use Type B, D, or E concrete for pavement patching complying with Section 901. Allowable for use are approved set-accelerating admixtures, complying with 1011.02, at the dosage recommended by the admixture manufacturer. Place, consolidate, finish, and cure the concrete as directed.

Texture the patch surface to match the texture of adjoining pavement. If pavement is to be overlaid, only drag finish the patched surface. The finished patched surface profile shall meet a maximum 1/4 inch deviation using an approved minimum 10-foot metal static straightedge.

Immediately after finishing, apply curing compound at one gallon per 100 square feet that results in the surface looking like a blank sheet of white paper.

Keep patches closed to traffic until standard test specimens conforming to the DOTD Materials Sampling Manual and 601.03.7 have attained a compressive strength of 3000 psi when tested in accordance with DOTD TR 230. Cure and transport cylinders to be tested in 24 hours or less in an insulated container without artificial heating until time of testing. Only with the Chief Construction Engineer's approval, can the maturity method be utilized for compressive strength determination.

Saw and seal transverse joints as shown on the plans. Reestablish the longitudinal joint to match the existing longitudinal joint. Use an appropriate sized backer rod material for the joint size complying with 1005.02.1. Use a sealant complying with 1005.02.1 in accordance with the manufacturer's recommendations. Keep the patches closed to traffic until the sealants have satisfactorily cured.

In areas where a bond breaker is required in longitudinal joints, use a 6-mil (nominal) polyethylene sheet or approved equal bond breaker. Place the bond breaker to the full thickness of the slab.

Base acceptance and payment for full depth patching of jointed concrete pavement on a lot basis at the contract unit price per square yard, adjusted in accordance with the following provisions. A lot will be a completed section or an identifiable pour completed in one day.

Base the acceptance and payment for each lot on the compressive strengths of Table 601-3.

**602.09 High Early Strength (HES) Concrete Pavement Full and Partial Depth Patching.**

For early opening to traffic, attain a minimum compressive strength of 3,000 psi within the lane closure time frame specified in the plans, contract documents or where construction conditions merit. Verify by trial batch that the proposed HES concrete mix achieves a minimum compressive strength of 3000 psi within the specified time frame. Mold and cure compressive strength specimens in accordance with DOTD TR 226 and test in accordance with DOTD TR 230. Cure and transport cylinders to be tested within 24 hours or less in an insulated container without artificial heating until time of testing. Use curing boxes for the molded cylinders to emulate the strength gain of the in-place concrete. Only with the Chief Construction Engineer's approval, can the maturity method be utilized for compressive strength determination.

Do not allow traffic on the high early strength concrete pavement until it obtains a minimum compressive strength of 3,000 psi.

Use a rapid setting patching material conforming to the AML or a Type B, D, or E concrete mix design, which conforms to the following requirements:

1. Allowable for use is Type III cement. For partial depth patching, use the same type of coarse aggregate, gravel or crushed stone, as the existing in-place PCCP.
2. Follow the manufacturer or supplier's recommendations on mixing and placing high early strength concrete pavement.
3. Do not use chloride-type accelerating admixtures.

Due to the rapid setting properties of the concrete, place the concrete as continuously as possible to eliminate cold joints. Promptly finish the concrete as specified in 601.03.9. Immediately after finishing, apply curing compound at one gallon per 100 square feet that results in the surface looking like a blank sheet of white paper.

Texture the patch surface to match the texture of adjoining pavement. If pavement is to be overlaid, only drag finish the patched surface. The finished patched surface shall meet the surface finish requirements of 601.03.11 except the

finished patched surface profile shall meet a maximum 1/4 inch deviation using an approved minimum 10-foot metal static straightedge.

**602.10 PARTIAL DEPTH PATCHING OF JOINTED CONCRETE PAVEMENT.** Patch partial depth concrete pavement in accordance with plan details and as follows.

**602.10.1 Patch Preparation.** Perform pavement cutting with a concrete saw along the perimeter of the pavement as marked by the engineer. Make the saw cut to the depth of unsound concrete, as determined by the engineer, but not less than 2 inches or more than 6 inches. If the depth of unsound concrete exceeds 6 inches, place a full-depth patch under that pay item. Remove unsound concrete within the patch area with approved pneumatic tools having a maximum weight of 30 pounds.

Clean the concrete surfaces within the patch area of loose particles, oil, dust, traces of asphalt concrete, joint material, and other contaminants by sandblasting before patching. Remove all sandblasting residue prior to placement of the bonding agent and patching material.

Reestablish and maintain transverse and longitudinal joints prior to placing repair material. Place fiberboard or other approved joint-forming material in the joint to the depth of the joint. Match and maintain all joints adjacent to patched areas in working condition.

**602.10.2 Patching Material.** Use either portland cement concrete or epoxy mortar for partial depth patching of concrete pavement.

When portland cement concrete is used for patching material in partial depth patches, the concrete will be accepted on a lot basis at the contract unit price per square yard. Base the acceptance and payment for each lot on the compressive strengths of Table 601.3.

**602.10.2.1 Portland Cement Concrete.** Use Type E portland cement concrete for pavement patching complying with Section 901, except use only a coarse aggregate Size 89M or 67 aggregate gradation complying with Table 1003-18. Use coarse aggregate DOTD Size 89M or ASTM C-33 Size 8 aggregate gradation for patches less than 2 ½ inches in depth. Use only non-chloride type accelerators, which may be added at the jobsite or plant.

Add steel fibers complying with ASTM A-820, Type I, or II to the mix. Use fibers with a nominal length not less than 1 inch or no greater than 1 1/2 inches. Use deformed fiber with an aspect ratio not less than 40 or no greater than 60. Provide 85 to 90 pounds of steel fibers per cubic yard of concrete. The fibers shall remain packaged until they are included in the mix. Ensure that fibers are uniformly distributed throughout the mix without any clumping. Continue mixing at the manufacturer's recommended mixing speed for at least 1 minute after addition of

the fibers. Mixer capacity prior to the addition of the fibers shall not exceed 80 percent.

**602.10.2.2 Epoxy Mortar.** Use an epoxy mortar for patching material that consists of a mixture of epoxy resin system and thoroughly dry fine aggregate. Use a Type I Grade 2 epoxy resin system, light gray in color, complying with Section 1017. Mix the epoxy components in strict compliance with the manufacturer's mixing recommendations before adding the fine aggregate to the mixture. Discard any epoxy mortar that begins to generate appreciable heat or is not in accordance with manufacture's recommendations. Use a prepackaged oven-dried construction sand as the fine aggregate. Prior to mixing, assure that the sand is in oven dry condition. The mixture proportions of the epoxy mortar shall be one part epoxy resin system to approximately three parts construction sand, by dry volume. Proportion the final mix such that during placement the slump of the mixture will allow the material to fill all voids, facilitating consolidation and finish. Store, proportion, and blend all ingredients of the epoxy mortar to yield a uniformly combined and homogenous mix.

### **602.10.3 Construction Requirements.**

**602.10.3.1 Portland Cement Concrete.** Clean concrete surfaces within the patch area of loose particles, dust and debris, and apply a bonding grout to the existing concrete in the patch area with a stiff bristle brush just before placement of the new concrete. Use grout consisting of equal parts of portland cement and sand by weight with enough water to provide a stiff slurry. Continuously agitate the grout and use within 90 minutes.

Place, consolidate, finish, and wet cure the concrete as directed.

The patch surface shall conform to the existing surface; texture to match the texture of adjoining pavement. The finished patched surface shall meet the surface finish requirements of 601.03.11 except the finished patched surface profile shall meet a maximum 1/4 inch deviation using an approved minimum 10-foot metal static straightedge.

After placement, consolidation and curing of the concrete, saw and seal transverse joints as shown on the plans with a sealant complying with 1005.02.1 in accordance with the manufacturer's recommendations. Reestablish the longitudinal joint to match the existing longitudinal joint. Use an appropriate sized backer rod material for the joint size complying with 1005.02.1.

Keep patches closed to traffic until standard test specimens conforming to 601.03.7 have attained a compressive strength of 3000 psi when tested in accordance with DOTD TR 230. Cure and transport cylinders to be tested in 24 hours or less in an insulated container without artificial heating until time of testing. Only with the Chief Construction Engineer's approval, can the maturity method be utilized for compressive strength determination.

Keep the patches closed to traffic until the sealants have satisfactorily cured.

**602.10.3.2 Epoxy Mortar.** Heavily prime the surface of the repair areas with neat blended epoxy immediately before placement of the epoxy mortar. Place and tamp the mixture with sufficient effort to eliminate voids and to thoroughly consolidate the mixture. Finish all patches to the cross section of the existing pavement.

After the epoxy mortar has been placed, saw and seal all transverse joints as shown on the plans with a sealant complying with 1005.02.1 in accordance with manufacturer's recommendations. Reestablish all longitudinal joints to match the existing longitudinal joints. Backer rod material shall comply with 1005.02.1. The patch surface shall conform to the existing surface; texture to match the texture of adjoining pavement. The finished patched surface shall meet the surface finish requirements of 601.03.11 except the finished patched surface profile shall meet a maximum 1/4 inch deviation using an approved minimum 10-foot metal static straightedge. Keep patches closed to traffic for at least 2 hours at air temperatures of over 60°F, and at least 4 hours at lower air temperatures unless otherwise recommended by the manufacture.

Keep the patches closed to traffic until the sealants have satisfactorily cured.

**602.11 PATCHING CONTINUOUSLY REINFORCED CONCRETE PAVEMENT.** Remove and replace continuously reinforced portland cement concrete pavement at locations shown on the plans or as directed and as follows.

Conduct patching operations in one lane at a time. Keep patches closed to traffic until standard test specimens conforming to 601.03.7 have attained a compressive strength of 3,000 psi when tested in accordance with DOTD TR 230.

Cure and transport cylinders to be tested in 24 hours or less in an insulated container without artificial heating until time of testing. Only with the Chief Construction Engineer's approval, can the maturity method be utilized for compressive strength determination.

If unable to complete the repair within the allotted time, temporarily backfill the patch area and keep closed to traffic until the patch is completed.

Prior to pavement removal, outline the patch splice area by saw cutting the pavement to a minimum depth of 1 1/2 inches. Cut the pavement full depth a distance of 18 inches inward from the edges of the patch splice area or as shown on the plans. Remove pavement without bending or damaging reinforcing bars projecting into the patch splice area. Do not use hammers exceeding 40 lbs for pavement removal in the 18-inch splice area. Remove deteriorated base course in the patch area and replace with concrete as directed. Remove and replace base course in the patch area, damaged by the contractor, with concrete as directed by the engineer at no cost to

the Department. Place an approved bond breaker between the concrete patched base course and the pavement at no direct pay.

Furnish Grade 40 or 60 deformed reinforcing steel of the same size as the removed steel and tie to projecting steel bars to provide at least 16 inches of lap. Place transverse steel first on approved chairs, then place longitudinal bars on transverse bars and tie at bar intersections.

Place nominal 6-mil polyethylene sheeting over exposed underdrain system areas before placement of concrete. Do not damage the existing shoulder surfacing, base course, and underdrain system during repair operations. Repair shoulder surfacing, base course, and underdrain system damaged by the contractor at no cost to the Department.

Use Type B, D, or E concrete for pavement patching complying with Section 901. If utilized, only use an approved non-chloride type set-accelerating admixture complying with 1011.02 at the dosage recommended by the admixture manufacturer. Allow the addition of the set accelerator at the jobsite. Clean the vertical concrete surfaces within the patch area of loose particles, oil, dust, and other contaminants. Coat the vertical surfaces of existing pavement in the patch areas with a neat cement grout immediately prior to placement of new concrete. Place, consolidate, finish, and cure the concrete. Texture the patch surface to match the adjoining pavement. The finished patch surface shall meet the surface finish requirements of 601.03.11 except the finished patched surface profile shall meet a maximum 1/4 inch deviation using an approved minimum 10-foot metal static straightedge.

A lot will be a completed section or an identifiable pour completed in one day. Base the acceptance and payment for each lot on the compressive strengths of Table 601-3. Make payment for deteriorated base course removed, as directed by the engineer, and replaced with concrete in accordance with 602.17.7.

**602.12 DIAMOND GRINDING CONCRETE PAVEMENT.** Uniformly grind and texture existing portland cement concrete pavement roadway surfaces longitudinally using a diamond grinder in accordance with the plans and specifications or as directed and as follows.

**602.12.1 Construction.** Uniformly grind and texture areas of the pavement surface as designated on the plans to eliminate joint and crack faults and to provide a constant pavement cross slope within the designated grinding limits in each lane. When checked with a 3-ft straightedge, grind the adjacent sides of transverse joints and cracks until flush whereby both sides of the transverse joints and cracks are in the same plane.

Produce a consistent cross slope with assured water drainage without abrupt edges between passes of the grinding machine. When tested with a 10-foot straightedge perpendicular to centerline, the variation shall not exceed 1/4 inch.

Provide the surface of the ground pavement with a corduroy-type texture consisting of parallel grooves between 3/32 inches and 5/32 inches wide, with a distance between grooves of 1/16 inch to 1/8 inches and a difference between the peaks of the ridges and the bottom of the grooves of approximately 1/16 inches. Adjust blade spacing as necessary when the results fail to come within 25 percent of these criteria. If, in the engineer's opinion, the peak's height is not adequate to provide good skid resistance, remove the blades and use a wider spacer.

Inspect the pavement texture, which is a function of blade width, blade spacing, and cutting head alignment, after each new or rebuilt cutting head has ground 1000 lineal feet.

Promptly remove slurry or residue that results from the grinding operation. Prevent slurry flow across lanes occupied by public traffic, or into gutters or other drainage facilities. When practical, slurry may be disposed of on the slope near the shoulder edge as the machine progresses down the roadway, unless otherwise directed. Conduct a final sweeping with power equipment before opening the pavement to traffic. Grind after removing raised pavement markers, patching, and load transfer restoration. Grind before joint sealing, striping, and replacing raised pavement markers.

Begin and end grinding from locations normal to the pavement centerline. Do not leave the grounded area slick or polished. The entire travel way shall be ground as indicated on the plans, specifications, or as directed.

**602.12.2 Equipment.** Grind by sawing with an industrial diamond abrasive impregnated in the saw blades. Assemble the saw blades in a cutting head mounted on a self-propelled machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the concrete pavement or joint faces. Ensure that grinding equipment does not cause ravels, aggregate fractures, spalls, or disturbance to the joints. Grinding equipment shall be capable of working in a closed lane, adjacent to an open traffic lane.

Each self-propelled machine shall be capable of cutting a minimum path 3 feet wide and within 12 inches of the face of a concrete curb. Furnish sufficient equipment to complete the project in the working time specified.

Provide vacuuming and sweeping equipment for the removal of the slurry, residue, and excess water.

### **602.12.3 Final Surface Profile.**

**602.12.3.1 PCC Pavements.** Meet acceptance requirements in 601.03.11.4.

**602.12.3.2 Localized Spot Grinding of Joints and Irregular Areas on Existing PCCP.** After completion of grinding and texturing, the

engineer will test the pavement surface for smoothness with a 10-foot straightedge at areas specified for grinding. The engineer will identify pavement areas that deviate more than 3/16 inches from the straightedge as defective work. The contractor may perform corrective work, but is not allowed to surface patch.

## **602.13 DIAMOND GROOVING CONCRETE PAVING.**

**602.13.1 Construction.** Begin and end transverse or longitudinally grooved areas normal to the pavement's centerline.

Begin longitudinal grooving 6 inches from the outside edge of pavement or reflective marker and run in a continuous pattern across the lane surface to within 6 inches of all longitudinal joints.

Begin and end continuous transverse grooving 12 inches from the outside edges. Cut transverse grooves no closer than 3 inches or more than 6 inches from a transverse joint.

For longitudinal grooving, cut grooves in a pattern 1/8 inches wide by 3/16 inches deep with a center-to-center spacing of 3/4 inches. For transverse grooving, cut grooves in a pattern 1/8 inches wide by 3/16 inches deep with a random center-to-center spacing as specified in 601.03.9.8.

Promptly remove slurry or residue that results from the grooving operation. Prevent slurry flow across lanes occupied by public traffic, or into gutters or other drainage facilities. When practical, slurry may be disposed of on the slope near the shoulder edge as the machine progresses down the roadway, unless otherwise directed. Conduct a final sweeping with power equipment before opening the pavement to traffic.

**602.13.2 Equipment.** Furnish a multi-blade arbor and a minimum cutting head width of 3 feet. The grooving machine control device must align the grooves, detect variations in the pavement surface, and automatically adjust the cutting head height to maintain the specified depth. Furnish a full complement of grooving blades and spacers capable of cutting grooves to the specified width, depth, and spacing.

**602.13.3 Final Surface Tolerances.** Meet the tolerances specified below:

Spacing  $\pm 1/8$  in.

Depth  $\pm 1/16$  in.

Width  $\pm 1/64$  in.

The engineer may allow the width of grooves on curves and super elevations to slightly exceed the above tolerances.

**602.14 LONGITUDINAL SHOULDER JOINT.** Construct a longitudinal joint in designated asphalt concrete shoulder surfacing adjacent to the PCCP in accordance with the plans or as directed and as follows.

Form joints by sawing a slot approximately 1/2-inch wide and 1/2-inch deep in the asphalt concrete shoulder adjacent to the PCCP. Flush the slot clean and dry immediately after sawing.

Just prior to placing joint sealant, blow the joint free of debris and water with compressed air. The compressor shall have an approved oil and water trap. The joint shall be dry before sealing. Seal prepared joints within 24 hours. Reclean joints that have become contaminated or dirty before sealing as directed. In areas where the shoulder has separated more than 1/2-inch from the pavement edge, place backer rod material in the joint prior to sealing.

Sealing materials shall be hot poured sealant complying with 1005.02.1. Install in accordance with the sealant manufacturer's recommendations. Keep the sealed joint closed to traffic until the sealant has satisfactorily cured to tack free.

**602.15 REMOVAL OF EXISTING SHOULDER UNDERDRAIN SYSTEMS.**

Remove the existing shoulder underdrain system including the outfall and backfill the trench as required by the plan details or as directed and as follows.

Remove the existing cap at the pavement edge and at the outfall locations, along with the geotextile fabric, pipe, fittings, aggregate, and other incidentals associated with the shoulder underdrain system. Place particular attention on removing the geotextile fabric adjacent to the pavement edges. Ensure the removal of all fabric. Complete installation and remove the concrete headwall and rodent screen. Abandon the outfall pipe by plugging in accordance with 701.11 and backfilling to the satisfaction of the engineer.

Do not open more trench than can be closed in the same day.

Replace shoulder drains in accordance with Section 703 or the plans.

**602.16 UNDERSEALING OR SLABJACKING PAVEMENT.** Drill holes in concrete pavement and pump fly ash/cement slurry under the pavement to fill cavities (undersealing) or to raise the elevation of the pavement slabs (slabjacking).

**602.16.1 Materials.**

**602.16.1.1 Portland Cement.** Use Type I cement and comply with Section 1001.

**602.16.1.2 Water.** Comply with 1018.01.

**602.16.1.3 Fly Ash.** Comply with 1001.04.

**602.16.1.4 Powdered Ammonium Lignin Sulfonate.** The cementitious mix may include powdered ammonium lignin sulfonate for its rheological and water-reducing properties.

## **602.16.2 Equipment**

**602.16.2.1 Air Compressors and Drills.** Use air compressors equipped with airlift pneumatic drills capable of drilling the required holes.

**602.16.2.2 Mixer.** Use high-speed (800 to 2000 rpm) colloidal mixers, or as approved, capable of thoroughly mixing slurry ingredients.

**602.16.2.3 Roller.** Use a pneumatic-tire vehicle capable of exerting a single-axle load of 9 tons.

## **602.16.3 Proportioning and Consistency.**

**602.16.3.1 Proportioning.** The slurry shall consist of one part portland cement and three parts fly ash by volume and water sufficient to meet the consistency requirements of 602.15.3.2. If utilized, add powdered ammonium lignin sulfonate at the rate of 0.5 to 1.5 percent by weight of cement.

**602.16.3.2 Consistency.** The slurry shall be of such consistency that the efflux time from the flow cone, when tested in accordance with DOTD TR 633, is 12 to 18 seconds for undersealing, and 15 to 26 seconds for slabjacking.

## **602.16.4 Construction Requirements**

**602.16.4.1 General.** Drill holes of approximately 1-1/2 inches in diameter through the pavement at locations shown on the plans or as directed. Rotate drills to avoid cracking pavement and hold as nearly perpendicular as possible to pavement surfaces. Clean holes with compressed air prior to undersealing. Fill any unusable holes with slurry and drill new holes. Do not drill more holes than can be used or filled during a day's operations. After drilling holes, connect a pipe to the discharge hose of the pressure pump and insert into the hole. Do not allow the discharge end of the pipe to extend below the bottom of pavement.

When pooling of slurry occurs, provide additional holes in the slab as directed. Pump more slurry through these new holes to fill voids between pools.

When backpressure forces slurry out of the hole onto the slab after withdrawal of discharge pipe, temporarily plug the hole until the slurry has set. After completion of pumping in a hole, remove the discharge pipe or plug and fill the hole with slurry.

Keep drainage structures clean of slurry mixture. Monitor all drainage structures within the affected areas. When the pumping operation is forcing the slurry into a drainage structure, discontinue pumping operations and immediately clean the drainage structure of slurry mixture.

When directed, proof roll undersealed or slabjacked pavements with the specified roller at no direct pay; however, do not conduct proof rolling until at least 24 hours after completion of undersealing. When such proof rolling indicates that cavities exist beneath the slab, fill such cavities as directed at no direct pay.

Promptly remove slurry or residue that results from undersealing or slabjacking operations. Prevent slurry flow across lanes occupied by public traffic, or into gutters or other drainage facilities. When practical, slurry may be disposed of on the slope near the shoulder edge as the machine progresses down the roadway, unless otherwise directed. Conduct a final sweeping with power equipment before opening the pavement to traffic.

**602.16.4.2 Undersealing.** Fill all voids beneath pavement with pumped slurry. Fill all cavities within range of the pumped hole as evidenced by lifting of the slab or slurry flowing out of an adjacent hole, through pavement joints or cracks, or out of the shoulder-pavement joint. Do not exceed pumping pressures over 200 psi. When pressures cause pavement lifting, use a lower pumping pressure. Lifting of the slab as a result of pumping shall not exceed 1/8 inch. Monitor the slab lifting by approved methods at all times during undersealing. Terminate all pumping operations that cause voids to form under the pavement in the immediate area. The sequence of pumping from hole to hole shall be as directed.

**602.16.4.3 Slabjacking.** Conduct pumping operations for slabjacking in an approved manner and sequence. Monitor the slab lifting at all times during pumping operations. Raise pavement slabs to the required grade by continuous pumping with a tolerance of  $\pm 1/8$  inch.

**602.16.5 Dowel Bar Retrofit.** Install plastic coated 1 1/2 inch diameter by 18-inch long plain round dowel bars into slots cut across and through existing concrete pavement transverse joints. Remove the existing portland cement concrete pavement from the slots and retro fit the dowel bars across the pavement joints. Fill the voids surrounding the dowel bars with a rapid setting concrete patching material on the AML. Saw and seal the transverse joints as required in the plans. All work shall conform to the plans, and the following requirements.

Patented processes or devices for simultaneous cutting of slots for dowel bar retrofiting shall conform to 107.03.

**602.16.5.1 Materials.** Dowel bars shall be in accordance with 1009.03.

The dowel bars shall have tight fitting plastic end caps that allow for 1/4-inch bar movement at each end of the bar. Submit an end cap sample to the project engineer for approval prior to installation.

Use nonmetallic chair devices to support and hold the dowel bars in place. The chairs shall be in contact with the bottom and sides of the slot in order to maintain horizontal and vertical dowel bar alignments. Submit a chair sample to the project engineer for approval prior to installation.

The foam core board filler material shall be 1/4-inch thick constructed of closed cell foam and faced with poster board material on each side.

Use a silicone caulk that on the AML for sealing the existing transverse joint at the bottom and sides of the slot.

Select an Approved Materials List low shrinkage cementitious concrete patching material to backfill the slots listed under Rapid Setting Patching Materials for Concrete that meets the following requirements when tested at the water content used at the project site:

1. Compressive strength 3 hr., minimum 3,000 psi - ASTM C 109
2. Compressive strength 24 hr., minimum 5,000 psi - ASTM C 109
3. Shrinkage 4 days, 0.13 percent maximum - ASTM C 157

Obtain and provide the manufacturer's technical specifications for approval of the patching product including all additives required to meet the minimum compressive strengths.

Curing compounds recommended by the patching material manufacturer shall be in accordance with Section 1011.

**602.16.5.2 Construction Requirements.** Install the dowel bars as follows:

Saw cut slots in the pavement parallel to the centerline of the roadway to a depth sufficient to place the center of the dowel bar at mid-depth in the pavement. Multiple saw cuts parallel to the centerline may be required to properly remove the material from the slot. Make the saw cuts for the slots at each transverse joint such that the dowel bars can be positioned parallel to the roadway centerline and surface in accordance with plan details.

Jackhammers used to break loose concrete shall not be larger than the 30-pound class. If the 30-pound jack hammer damages the pavement, use a lighter weight hammer.

Sand blast and clean all exposed surfaces and cracks in the slot prior to bar installation. Equip air compressors with approved oil and moisture traps.

Fill the transverse contraction joint on the bottom and the sides of the slot with silicone caulk. Prior to patching, clean all caulking material from the bottom and sides of the slot that will result in breaking of the bond with the patching material.

Lightly oil or grease the dowel bars prior to placement. The bar chairs shall provide a minimum of 1/2-inch clearance between the bottom of the dowel bar and the bottom of the slot. Center the dowel bars over the transverse joint. Place the bar in the middle of the slot to the depth shown on the plans, parallel to the roadway centerline and the roadway surface. The chairs shall hold the dowel bar securely in place during placement of the patching mix.

Place a 1/4-inch thick foam core board at the middle of the dowel bar to maintain the transverse contraction joint. Cut or remove the existing joint sealant if necessary to accommodate the foam core board. The foam core board shall fit tightly around the dowel bar and to the bottom and edges of the slot. Place the top of the foam

core board flush with the top surface of the concrete pavement. The foam core board shall remain in a vertical position and be tight to all edges during the placement of the patching material.

Thoroughly moisten all surfaces on the sawed slot immediately prior to filling with patch compound unless the patching material manufacturer recommends the slot surface to be dry. Take care to prevent standing water in the slot. Remove all excess water with compressed air.

Fill the slot (with the installed dowel bar, chairs, foam core board, and silicone in place) with an approved patching material. Mix the patching material in accordance with the manufacturer's recommendations and with mixing equipment approved by the engineer. Vibrate the patching material with a small hand held vibrator capable of thoroughly consolidating the patching compound into the slot and around the dowel bar. Trowel finish and cure the top surface of the filled slot. Cure the patched areas as recommended by the patching material manufacturer.

Provide six 2-inch cube molds in accordance with ASTM C 192 for sampling and testing the patching material once for each 4 hours of production or a minimum of once per day. Make test specimens in accordance with ASTM C 192. If the compressive strengths are not being met, cease production and take corrective measures to the satisfaction of the engineer.

Allow the patching material to cure for a minimum of four hours before placing any vehicle loads on the repair or as directed.

Saw the transverse joints then seal with a sealant complying with 1005.02.3 in accordance with plan details and the manufacturer's directions. Use an appropriate sized backer rod material for the joint size complying with 1005.02.1. Use an Approved Materials List backer rod material.

Repair or replace all nonfunctioning or damaged dowel bars at no cost to the Department.

**602.17 MEASUREMENT.** Measurement of portland cement concrete pavement rehabilitation will be as follows:

1. Measure Cleaning and Filling Existing Longitudinal Pavement Joints by the linear foot.
2. Measure Cleaning and Resealing Existing Longitudinal and Transverse Pavement Joints by the linear foot.
3. Measure Cleaning and Sealing Cracks by the linear foot along the centerline of the crack at the pavement surface.
4. Measure Full Depth Corner Patching of Jointed Concrete Pavement by the square yard.
5. Measure Full Depth Patching of Jointed Concrete Pavement by the square yard.

6. Measure Partial Depth Patching of Jointed Concrete Pavement by the square yard.
7. Measure Patching of Continuously Reinforced Concrete Pavement by the square yard.
8. Measure Grinding by the square yard. Measurement will be of the final ground area. Pavement ground area will be determined by multiplying the width of the ground area by the horizontal length ground.
9. Measure Grooving of Concrete Pavement by the square yard. Determine the quantity of pavement grooving by multiplying the width and length of the grooved pavement. No deductions will be made for grooving omitted at edges, joints, manhole, or other devices.
10. Measure Longitudinal Shoulder Joints by the linear foot.
11. Measure Removal of Existing Shoulder Underdrain Systems by the linear foot along the pavement edge.
12. Measure Undersealing Pavement or Slabjacking Pavement by the ton of portland cement used in the slurry. Measure holes for undersealing or slabjacking per each. There is no measure for fly ash or slag, admixtures, and water for payment.
13. Measure dowel bar retrofit per each dowel bar installed and accepted.

**602.18 PAYMENT.** Payment for portland cement concrete pavement rehabilitation includes furnishing all labor, materials, tools, equipment, and all incidentals for performing the work specified.

**602.18.1 Cleaning and Filling Existing Longitudinal Pavement Joints.** Payment will be made at the contract unit price per linear foot.

**602.18.2 Cleaning and Resealing Existing Longitudinal and Transverse Pavement Joints.** Payment will be made at the contract unit price per linear foot.

**602.18.3 Cleaning and Sealing Cracks.** Payment will be made at the contract unit price per linear foot.

**602.18.4 Full Depth Corner Patching of Jointed Concrete Pavement.** Payment will be made at the contract unit price per square yard. Base the payment for deteriorated base course removed and replaced with concrete, as directed by the engineer, and as follows: The value per inch thickness of corner patching will be determined by dividing the contract unit price per square yard by the plan thickness. Measure the thickness of patches from the surface that exists at the time of patching to the top of base course. Payment for the additional thickness of base course replaced with concrete will be made at 50 percent of the value per inch thus determined.

**602.18.5 Full Depth Patching of Jointed Concrete Pavement.** Base acceptance and payment for full depth patching of jointed concrete pavement on a lot basis at the contract unit price per square yard, adjusted in accordance with the following provisions. A lot will be a completed section or an identifiable pour completed in one day. Base the acceptance and payment for each lot on the compressive strengths of Table 601-3. Payment will be at the contract unit price per square yard as specified in 602.08.

Base payment for deteriorated base course removed and replaced with concrete, as directed by the engineer, and as follows: The value per inch thickness of full depth pavement patching will be determined by dividing the contract unit price per square yard by the plan thickness. Measure the thickness of patches from the surface that exists at the time of patching to the top of base course. Payment for the additional thickness of base course replaced with concrete will be made at 50 percent of the value per inch thus determined.

**602.18.6 Partial Depth Patching of Jointed Concrete Pavement.** Make payment for partial depth patching of jointed concrete pavement will be made at the contract unit price per square yard.

When portland cement concrete is used for patching material in partial depth patches, the concrete will be accepted on a lot basis at the contract unit price per square yard. Base the acceptance and payment for each lot on the compressive strengths of Table 601-3.

**602.18.7 Patching Continuously Reinforced Concrete Pavement.** Make payment for continuously reinforced concrete pavement, on a lot basis, at the contract unit price per square yard, adjusted in accordance with the following provisions. A lot will be a completed section or an identifiable pour completed in one day. Base the acceptance and payment for each lot on the compressive strengths of Table 601-3.

Payment for patching continuous reinforced concrete pavement per square yard includes furnishing all labor, materials, tools, and incidentals for performing the work as specified in 602.10.

Make payment for deteriorated base course removed, as directed by the engineer, and replaced with concrete as follows: The value per inch thickness will be determined by dividing the contract unit price per square yard by the plan thickness. Measure the thickness of patches from the surface that exists at the time of patching. Payment for the additional thickness will be made at 50 percent of the value per inch thus determined.

**602.18.8 Grinding Concrete Pavement and Joints.** Payment will be made at the contract unit price per square yard.

**602.18.10 Longitudinal Shoulder Joint.** Payment will be made at the contract unit price per linear foot.

**602.18.11 Removal of Existing Shoulder Underdrain Systems.**

Payment will be made at the contract unit price per linear foot.

**602.18.12 Undersealing and Slabjacking Pavement.** Payment will be made at the contract unit price per ton of portland cement. Payment for holes will be per each.

**602.18.13 Dowel Bar Retrofit.** Payment will be made at the contract unit price per each.

Payment will be made under:

<b>Item No.</b>	<b>Pay Item</b>	<b>Pay Unit</b>
602-01	Cleaning and Filling Existing Longitudinal Pavement Joints	Linear Foot
602-02	Cleaning and Resealing Existing Longitudinal and Transverse Pavement Joints	Linear Foot
602-03	Cleaning and Sealing Cracks	Linear Foot
602-04	Full Depth Corner Patching of Jointed Concrete Pavement	Square Yard
602-05	Full Depth Patching of Jointed Concrete Pavement	Square Yard
602-06	Partial Depth Patching of Jointed Concrete Pavement	Square Yard
602-07	Patching Continuously Reinforced Concrete Pavement	Square Yard
602-08	Diamond Grinding Concrete Pavement	Square Yard
602-09	Diamond Grooving Concrete Pavement	Square Yard
602-10	Longitudinal Shoulder Joints	Linear Foot
602-11	Removal of Existing Shoulder Underdrain Systems	Linear Foot
602-12	Undersealing Pavement	Ton
602-13	Slabjacking Pavement	Ton
602-14	Holes	Each
602-15	Dowel Bar Retrofit	Each
602-16	High Early Strength (HES) Concrete Pavement Full and Partial Depth Patching	Square Yard