PART VI -- RIGID PAVEMENT

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Section 601
Portland Cement Concrete Pavement

601.01 DESCRIPTION. This work consists of constructing portland cement concrete pavement, on a prepared subgrade or base course in accordance with these specifications and in conformity with the lines, grades, thicknesses and typical cross sections shown on the plans or established by the engineer.

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" which is hereby made a part of the contract by reference.

601.02 MATERIALS. Materials shall comply with the following Sections or Subsections.

Portland Cement Concrete	901
Aggregates	1003
Joint Materials	1005
Tie Bars	1009.03
Dowel Bars	1009.04
Curing Materials	1011.01
Epoxy Systems	1017
Hydrated Lime	1018.03
Water	1018.01
Non-Shrink Grout	1018.26
Geotextile Fabric	1019

The contractor shall furnish either Type B or D concrete. The same type of concrete shall be used throughout the project, unless otherwise authorized in writing.

601.03 EQUIPMENT. Paving and miscellaneous equipment shall comply with the requirements of the appropriate subsection. The contractor shall submit, at least 7 days prior to paving, a list of his proposed equipment and tools necessary for handling materials and performing the work. All equipment shall be at the job site at least 24 hours prior to the start of

operations to be examined for approval. Equipment shall be so designed and operated as to assure placing and spreading of concrete without segregation.

(a) Vibrators: Vibrators for full width vibration of concrete slabs shall be internal type with either immersed tube or multiple spuds. They may be attached to the spreader or finishing machine or mounted on a separate carriage. Spacing of vibrators shall not exceed 18 inches (450 mm) when pavement is placed using the slip form method, and the vibrator spacing shall not exceed 24 inches (600 mm) when conventional forms are used. The first vibrator shall be approximately 12 inches (300 mm) from the edge of the slab. The attached vibrators shall be capable of being raised to prevent contact with joints, dowel bars, subgrade, forms or other features extending into the pavement. Frequency of submerged internal vibrators, both tube and spud vibrators, shall be 7,000 to 10,000 impulses per minute. This frequency also applies to internal vibrators used adjacent to forms. Vibrators mounted on any machine or carriage shall be interlocked with the forward travel mechanism so that they automatically start and stop vibrating when the machine starts and stops. Hand held vibrators shall be an approved type and design, capable of transmitting vibrations to concrete at frequencies of at least 4,500 impulses per minute.

(b) Sawing Equipment: When joints are sawed in accordance with Subsection 601.09, the contractor shall provide adequate equipment to complete the sawing to required dimensions, and in a timely manner to prevent cracking. The contractor shall have back-up equipment at the jobsite to continue sawing operations if the primary sawing equipment malfunctions.

(c) Forms:

(1) General: Forms shall have a depth not less than the specified edge thickness of pavement and a base width at least 0.8 of the depth, except as otherwise approved.

Forms shall be provided with adequate devices for secure setting. Flange braces shall extend outward on the base at least 2/3 the height of forms. Forms with battered top surfaces and bent, twisted or broken forms shall be removed from the work. Repaired forms shall not be used until inspected and approved.

Materials used for keyway forms will be subject to approval. Top face of forms shall not vary from a true plane more than 1/8 inch in 10 feet (3 mm in 3.0 m) and the upstanding leg shall not vary more than 3/8 inch (10 mm) from the vertical. Forms shall contain provisions for locking ends of abutting sections together tightly.

(2) Straight Forms: Straight forms shall be made of metal at least 7/32 inch (6 mm) thick and shall be furnished in sections at least 10 feet (3.0 m) long.

(3) Flexible or Curved Forms: Flexible or curved forms of proper radius shall be used on curves of 150-feet (45 m) radius or less and shall be an approved design. On curves with a radius greater than 150 feet (45 m), straight forms of shorter lengths will be permitted.

(4) Built-up Forms: When approved, built-up forms may be used; however, the build-up shall not exceed 2 inches (50 mm). No limitation will be made on the use of built-up forms or amount of build-up where the total area of pavement of a specified thickness is less than 2,000 square yards (2000 sq m).

(d) Screeds: Wooden or metal screeds used for hand finishing or mechanical Clary type screeds shall be at least two feet (0.6 m) longer than the slab width. Screed widths for slip form pavers and mechanical pavers that ride on forms equipped with pan type screeds shall be the full width of the slab. The type of screed to be used shall be approved by the engineer and be sufficiently rigid to retain its shape in order to finish the concrete to the required crown and elevation.

(e) 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 (1.5 m) long and 6 inches (150 mm) wide.

(f) Straightedge: Straightedges shall be approved minimum 10-foot (3.0 m) metal static straightedges with handles approximately 3 feet (0.9 m) longer than the lane width.

(g) Carpet Drag: Carpet drags shall consist of approved artificial turf. The artificial turf shall be made of molded polyethylene with synthetic turf blades approximately 0.85 inch (22 mm) long containing approximately 7200 individual blades per square foot (78,000 individual blades per sq m). The artificial turf carpet shall be full pavement width and of sufficient size that during the finishing operation approximately 2 feet (0.6 m) of carpet parallel to the pavement centerline will be in contact with the pavement surface for the full pavement width. For pavement 16 feet (5 m) or more in width, the artificial turf shall be mounted on a bridge that travels on the forms. If necessary for maintaining intimate contact with the pavement surface, the carpet may be weighted.

(h) Burlap Drag: The burlap drag shall consist of a seamless strip of damp burlap that shall produce a uniform gritty surface texture after dragging it longitudinally along the full width of the pavement. For pavement widths

16 feet (5 m) or more, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap at least 4 feet (1.2 m) wide is in contact with the full width of pavement surface. The drag shall consist of not less than two layers of burlap with the bottom layer approximately 6 inches (150 mm) wider than the upper layer.

(i) Tine Texturing Device: The tine texturing device shall have metal tines that produce randomly spaced grooves uniform in appearance and transverse to the pavement centerline. Tine dimensions and spacing requirements shall be in accordance with Subsection 601.08(h). The pavement shall have a continuously textured surface.

601.04 PREPARATION AND MAINTENANCE OF SUBGRADE OR BASE. The surface on which the concrete is to be placed shall be prepared and maintained in accordance with plan details and in such a manner that the pavement depth, grade and surface finish requirements will be met. Additional preparation needed for the support of construction equipment will be at no direct pay.

The subgrade or base course shall be cleaned of loose material and maintained in a satisfactory condition, and any deficient areas shall be corrected at no direct pay.

The subgrade or base course shall be graded to proper cross section. High areas shall be trimmed to grade. Areas below grade may be filled with concrete during paving. Failures, soft spots, or other damaged areas in bases and subgrade shall be repaired prior to concrete placement in accordance with Subsection 301.14. The finished grade shall be maintained in a smooth and compacted condition until pavement is placed. No concrete shall be placed until the subgrade or base course has been approved.

The contractor shall apply an approved mixture to the asphaltic 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, approved mixtures will consist of hydrated lime and water or a wax based white pigmented curing compound. The type of whitewash mixture used and application rate needed to prevent heat buildup or bonding will be the responsibility of the contractor. Other types of mixtures proposed by the contractor will be subject to Department approval.

601.05 PLACING FORMS.

(a) Base Support: The foundation under forms shall be firm and true to grade so that the form will be firmly in contact for its whole length or firmly shimmed at the required grade.

(b) Form Setting:

(1) General: Form sections shall be tightly locked and free from movement in any direction. No settlement or springing of forms under the finishing machine will be acceptable except as allowed by the project engineer. Face and top of forms shall be cleaned and oiled prior to placing concrete. A pin shall be placed at each side of every form joint. Pins shall be of sufficient length to provide adequate anchorage.

(2) Stabilized (or treated), Permeable Bases, and Asphaltic Concrete Base Courses: On asphaltic concrete base courses, or cement or lime stabilized or treated base courses, each 10-foot (3.0 m) section of forms shall be staked into place with at least two pins installed in full size drilled holes.

(3) Other Types of Base Courses or Subgrade: On other types of bases or subgrades, at least three pins will be required in each 10-foot (3.0 m) section. After forms have been set to correct grade and alignment, the base or subgrade shall be thoroughly tamped, mechanically or by hand, at both inside and outside edges of forms.

(c) Grade and Alignment: Alignment and grade of forms shall be checked and corrections made by the contractor prior to placing concrete. When any form has been disturbed or the grade or alignment has become unstable, the form shall be reset and rechecked. Form sections shall not deviate from required alignment by more than 3/8 inch (10 mm).

601.06 PLACING CONCRETE. The subgrade or base shall be uniformly moist when concrete is placed. When directed, the subgrade or base shall be sprinkled to dampen the surface, but the method of sprinkling shall not form mud or pools of water. Concrete shall be deposited on the base or subgrade in such manner as to require as little rehandling as possible. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels or other approved tools. Workers shall not walk in freshly mixed concrete with tools, boots or shoes coated with dirt or foreign substances.

When concrete is to be placed adjacent to previously constructed pavement, and equipment (except for saws) will be operated on the previously constructed pavement, the previously constructed pavement shall have attained an age of 10 days or a compressive strength of 3,000 psi (20.7 MPa) when tested in accordance with DOTD TR 230. The contractor shall protect the finish from damage. Hot and cold weather limitations of Subsection 901.11 shall apply.

When only light strike-off and finishing equipment is carried on existing pavement, paving of adjoining pavement will be permitted after 1 day, exclusive of days when temperature is below 40°F (5°C).

Concrete shall be placed as near to joints as possible without disturbing them.

601.07 TEST SPECIMENS. The contractor shall furnish concrete for casting test specimens as required at no direct pay. Test specimens will be made and cured in accordance with DOTD TR 226.

601.08 STRIKE-OFF, CONSOLIDATION AND FINISHING.

The normal sequence of operations is: strike-off and consolidation, screeding, floating and removal of laitance, straight edging, surface finishing, and tine texturing. The finishing machine used shall be designed for concrete paving and meet the approval of the engineer. The finishing machine shall be mechanically powered and shall be capable of spreading, consolidating, screeding and finishing the concrete to the required pavement elevation and cross section. Mechanical Clary type lane screeds will be allowed when approved by the engineer for projects with concrete pavement lane lengths of 1500 feet (450 m) or less, continuous paving lengths less than 600 feet (180 m), pavement gaps, intersections, or when side clearance is restricted. The finished pavement shall meet the surface tolerance required in Subsection 601.11 regardless of the type of finishing equipment used.

(a) Strike-off: Concrete shall be struck off to the specified cross section and to an elevation such that when concrete is properly consolidated and finished, the pavement surface shall be at the established elevation.

(b) Consolidation: Concrete shall be consolidated for full width and depth of the slab. Vibrators shall not be operated longer than 15 seconds in one location. If satisfactory density of concrete is not obtained, the contractor shall use methods which will produce pavement in compliance with the specifications.

(c) Consolidation and Finishing at Joint Forming Devices:

(1) Concrete adjacent to joints shall be compacted without voids or segregation against joint material, also under and around load transfer devices, joint assembly units and other features extending into pavement. Concrete shall be thoroughly consolidated, using internal vibrators or other acceptable methods, for its full width along the faces of forms and along the full length and on both sides of joint assemblies. When hand-held vibrators are used, care shall be taken to avoid excessive vibration.

(2) After concrete has been placed and vibrated adjacent to joints, the finishing operations shall be brought forward, operating in a manner to avoid damage or misalignment of joints.

(d) Screeding: Concrete, as soon as placed, shall be struck off and screeded with an approved screed.

The screed shall be moved forward on forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which work is progressing and so manipulated that neither end is raised from side forms during the striking off process. This shall be repeated until the surface is of uniform texture, true to grade and cross section and free from porous areas. The screed shall be controlled to maintain a uniform roll of concrete ahead of the screed.

(e) Floating: Floating to provide the final smooth surface will be required using an approved machine float. When necessary, following machine floating, long handled floats may be used to smooth and fill open-textured pavement areas. Long handled floats shall not be used to float the entire pavement surface in lieu of machine floating. When strike-off and consolidation are done by hand and the pavement crown will not permit use of the machine float, the surface shall be floated transversely with the long handled float. The crown shall not be worked out of the pavement.

(f) Straightedging: Excess water and laitance shall be removed from the pavement surface with a steel straightedge. The plastic concrete surface shall be tested for trueness with a straightedge. The straightedge shall be furnished and used by the contractor and shall be held in contact with the surface in successive positions parallel to pavement centerline. The whole area shall be checked from one side of the slab to the other. Advance along the surface shall be in successive stages of not more than 1/2 the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, and refinished. High areas shall be cut down and refinished. Attention shall be given to ensure that the surface across joints meets the requirements for smoothness. Straightedge testing and surface corrections shall continue until the entire surface is free from deviations from the straightedge and the slab conforms to required grade and cross section.

(g) Surface Finishing: In general, addition of water to the surface of concrete to assist in surface finishing operations will not be permitted. If application of water to the surface is permitted, it shall be applied as a fog spray by approved equipment.

During final surface finishing operations, areas that are improperly finished shall be refloated and refinished as required.

Surface finishing shall be with an approved carpet or burlap drag in accordance with Subsection 601.03(g) or 601.03(h). The drag used shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1/16 inch (2 mm) deep. The adjacent concrete shoulder will require the same finish as the pavement. The drag used shall be kept free of hardened concrete. Drags that cannot be cleaned, or show wear or produce unsatisfactory results shall be replaced.

(h) Tine Texturing: The metal tine texturing device shall be operated by approved mechanical means when texturing main roadway travel lanes. When approved, manual methods may be used 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. Tines shall be steel flat wire, 4 to 5 inches (100 to 125 mm) in length, randomly spaced, with a minimum spacing of 3/8 inch (10 mm) and a maximum spacing of 1 1/2 inch (40 mm). No more than 50 percent of the spaces shall exceed 1 inch (25 mm). The width of tines shall be 1/8 ± 1/64 inch (3.0 ± 0.5 mm). The depth of groove produced in the concrete shall be 3/16 inch (5 mm) maximum and 1/8 inch (3 mm) minimum, measured in accordance with DOTD TR 229. Pavement, which does not meet the above requirements, shall be corrected by regrooving.

The adjacent concrete shoulder will require the same finish as the travel lane. Tine texture on the shoulders will be visually inspected.

(i) Edging at Forms and Joints: Before tine texturing and before concrete has reached its initial set, the edges on each side of pavement and each side of transverse expansion joints, Type EJ modified joints, and longitudinal construction joints which are not sawed shall be worked with an approved tool and rounded to the radius specified. A well-defined, continuous radius shall be produced and a smooth, dense mortar finish shall be obtained. A work bridge shall be used to perform the working of joints. The pavement surface shall not be disturbed by tilting the tool during use.

Tool marks on the slab adjacent to joints shall be eliminated by brooming the surface, but the rounding of the slab shall not be disturbed. Concrete on top of joint filler shall be removed. Joints shall be tested with a straightedge before concrete has reached initial set and corrections made as necessary.

(j) Hand Finishing: Hand finishing methods will not be permitted except under the following conditions:

(1) In case of breakdown of mechanical equipment, hand finishing may be used to finish concrete already deposited on the grade when the breakdown occurs.

(2) Pavement widths not exceeding 15 feet (4.5 m) or areas of irregular dimensions where operation of mechanical equipment is impractical may be hand finished.

(k) Finish for Concrete to be Overlaid: If concrete pavement is to be overlaid with asphaltic concrete, tine texturing will not be required; and the pavement shall be satisfactorily finished to required lines, grades and typical section. Machine or hand finishing methods may be used. The final surface finish shall be equivalent to that normally achieved with a wood float.

601.09 JOINTS.

(a) Longitudinal Joint (Type LJ): The longitudinal joint shall be constructed such that the transverse joint is continuous across the slab. Deformed steel tie bars of specified length, size, spacing and material shall be placed perpendicular to longitudinal joints. They shall be placed by approved mechanical equipment or rigidly secured by chairs or other approved supports. Tie bars shall not be coated with asphalt or other material or enclosed in tubes or sleeves. When adjacent lanes of pavement are constructed separately, steel side forms or other approved methods shall be used. Only Grade 40 (Grade 300) tie bars may be bent at right angles against the form of the first lane constructed and straightened into final position before concrete of the adjacent lane is placed. Instead of bending tie bars, approved mechanical butt splicing devices complying with Subsection 806.07 may be used.

Tie bars that break or show evidence of fracture upon straightening shall be replaced when directed by using an approved adhesive anchor system listed in the QPL 52 or by epoxying with a Type I, Grade C epoxy resin system. When epoxy is used, holes for tie bars shall be drilled approximately 1/8 inch (3 mm) larger than the diameter of the bar to be anchored. Holes shall be clean and moisture free. Adhesive anchor systems shall be used in accordance with the manufacturer's recommendations.

The Type I, Grade C epoxy resin system shall be mixed in accordance with the manufacturer's recommendations with no fillers or extenders added. The maximum quantity of epoxy, which may be mixed, is that quantity that can be applied within the manufacturer's designated time limit depending upon ambient temperature or other job conditions. The surface of the steel tie bar shall be coated with epoxy. Epoxy shall be injected into the hole using a caulking gun or other approved method to completely fill the hole. Epoxy injected shall be sufficient to fill the void between the bar and hole as evidenced by epoxy squeeze-out when the bar is inserted. Precautions shall be taken to prevent bars from being disturbed until epoxy has sufficiently cured. Epoxy shall not be applied when ambient temperature is below 40°F (5°C).

When shoulder and roadway pavement slabs are placed separately, a longitudinal joint will be required between the slabs; however, when shoulder and roadway pavements are placed monolithically, and the total width of roadway and shoulder does not exceed 15 feet (4.5 m), no longitudinal joint will be required between the shoulder and roadway pavements. Ramps which exceed 15 feet (4.5 m) in width shall have a longitudinal joint at the centerline.

The contractor shall 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.

The longitudinal joint (Type LJ) shall be formed by sawing. The sawing operation shall begin as soon as the concrete has reached sufficient strength to support the sawing machine and tearing and raveling of the concrete does not occur. The sawing operation shall be completed in a timely manner such that cracking does not occur.

The initial joint width shall be a minimum of 1/8 inch (3 mm); joint depth shall be as specified in the plans. The joint sealant reservoir shall be sawed to a minimum width and depth shown on the plans. The joint sealant shall conform to Subsection 1005.02(a) or (c).

After each joint is sawed, the saw cut and adjacent concrete surfaces shall be cleaned of materials removed during sawing.

No equipment, other than the sawing machine, will be permitted on the pavement during sawing operations. Sufficient back-up equipment shall be provided at the jobsite to continue sawing operations in case of a breakdown of the primary sawing equipment.

During paving operations, joint locations shall be clearly marked by approved methods. When sawing operations are not providing proper crack control, the contractor shall modify sawing operations as required to provide proper crack control.

(b) Transverse Expansion Joints (Type EJ): Concrete disturbed during expansion joint installation shall be replaced with fresh concrete and vibrated with a surface vibrator. The sealer shall be a preformed elastomeric compression seal complying with Subsection 1005.03 or a two component rapid cure silicone complying with Subsection 1005.02(d). The expansion joint filler shall be one of the following types.

(1) Wood Filler: If wood filler conforming to Subsection 1005.01(b) is used to form the joint, the joint shall be sealed as specified. When wood filler is used, it shall be thoroughly saturated with water before installation. No board less than 6 feet (1.8 m) long shall be used.

Dowel Bars shall provide bracing adequate to hold the wood filler in a vertical position.

Wood fillers that are damaged shall not be used. Finished joints shall not deviate more than 1/4 inch (6 mm) in horizontal alignment from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted within the expansion space. Field modification of wood filler will not be allowed.

(2) 1 1/2 Inch (38 mm) Type EJ Modified: When a slip form paving method is used the contractor will be allowed to construct the transverse expansion joint with a 1 1/2 inch (38 mm) wide sawed joint over a bolster block. The bolster block shall be constructed from Class A Concrete or one of the pavement types complying with Section 901. One layer of tar paper equivalent to a minimum of 30 pounds per 100 square feet (15 kg per 9.0 sq m) shall be placed between the bolster block and the pavement. If the contractor elects to use the EJ modified joint, all the expansion joints shall be constructed using this method.

(c) Transverse Contraction Joints (Type TCJ): Transverse contraction joints shall consist of planes of weakness created in the cross section of the pavement. The joints shall include load transfer devices. Joints for pavement with a design speed greater than 45 mph (70 km/h) shall be constructed by sawing as specified in Heading (1) below. Joints for pavement with a design speed of 45 mph (70 km/h) or less may be constructed by any of the following methods.

(1) Joints shall be constructed by sawing after the concrete has reached sufficient strength to support sawing equipment. During paving operations, joint locations shall be clearly marked by approved methods. Joints may be either sawed to required joint width and depth at one time, or may be initially sawed to a width of approximately 1/8 inch (3 mm) and to the required joint depth and subsequently widened by sawing to required joint width. Sawing shall be to the specified depth for the full width of roadway or lane. When the transverse contraction joint cannot be sawed to the edge of the pavement due to forms, an insert shall be placed in the 6 inches (150 mm) adjacent to the forms. Initial sawing shall be done as soon as the concrete has hardened sufficiently that tearing of the concrete will not occur, and shall be completed in a timely manner such that cracking does not occur.

The joint sealant reservoir shall be sawed to the minimum width and depth shown on the plans.

After each joint is sawed, the saw cut and adjacent concrete surfaces shall be cleaned of materials removed during sawing.

No equipment other than the sawing machine and testing equipment will be permitted on the pavement during sawing operations. Sufficient back-up equipment shall be provided at the jobsite to continue sawing operations in case of a break-down of the primary sawing equipment.

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

The contractor shall repair any cracking, chipping, spalling or tearing of the concrete at no direct pay by approved methods to the satisfaction of the engineer.

(2) Install an approved removable joint device to form a joint to the required width and depth. A vertical plane shall be established prior to installing the removable 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 (6 mm to 10 mm) and a depth 1/4 inch (6 mm) greater than the depth of the insert. This device shall be vibrated in place and raised 1/2 inch to 3/4 inch (15 mm to 20 mm) while concrete is workable, with all laitance removed along side of insert. The insert shall remain in place at least 12 hours. These devices may be reused provided they are cleaned of foreign materials and are undamaged in removal.

(3) Install a combination joint former/sealer device as specified in Subsection 1005.04 to form a joint in fresh concrete to ensure proper bond and alignment. A vertical plane shall be established 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 (6 mm to 10 mm) and a depth 1/4 inch (6 mm) greater than the depth of the insert. The insert shall be vibrated in place until the concrete is properly consolidated against both sides of the seal. The top cap of the insert shall be flush with the top surface of the pavement at the completion of all finishing operations.

(d) Transverse Construction Joints (Type CJ): Transverse construction joints shall be constructed when there is an interruption of more than 1/2 hour in concreting operations. No transverse joint shall be constructed within 10 feet (3.0 m) of an expansion or contraction joint. If sufficient concrete has not been mixed at the time of interruption to form a slab at least 10 feet (3.0 m) long, concrete back to the preceding joint shall be removed and disposed of as directed. Hand vibrators shall be used to ensure proper consolidation of concrete adjacent to transverse construction joints. Joints shall include dowel bars.

(e) Longitudinal Construction Joint (Type LCJ): Longitudinal construction joints shall be constructed when adjacent lanes are constructed separately. Hand vibrators shall be used to ensure proper consolidation of

concrete adjacent to longitudinal construction joints. Joints shall include tie bars. A heavy coat of curing compound shall be applied to the adjacent face of the concrete before constructing the adjacent slab. Tie bars shall be protected from being coated with curing compound.

(f) Longitudinal Butt Joint (Type LBJ): Longitudinal butt joints shall be constructed when adding one or more additional lanes of pavement. Deformed tie bars of the specified length, size, spacing and material shall be placed perpendicular to longitudinal butt joints. Tie bars shall not be coated with asphalt or other material or enclosed in tubes or sleeves.

Tie bars shall be installed in holes drilled in the existing pavement using an approved adhesive anchor system listed in the QPL 52, or by using a Type I, Grade C epoxy resin system, as listed in QPL 32, or an approved cementitious grout anchor system, as listed in QPL 40. Holes shall be clean and moisture free.

Adhesive anchor systems shall be used in accordance with the manufacturer's recommendations. When epoxy is used, tie bars shall be placed in the existing pavement in holes drilled approximately 1/8 inch (3 mm) larger than the diameter of the tie bar to be anchored. When an approved cementitious grout anchor system is used, the bars shall be placed in the existing pavement in holes drilled approximately 1/2 inch (15 mm) larger than the diameter of the tie bar to be anchored.

The epoxy shall be mixed in accordance with the manufacturer's recommendations with no fillers or extenders added. The maximum quantity of epoxy, which may be mixed, is that quantity that can be applied within the manufacturer's designated time limit dependent upon ambient temperature or other job conditions. The surface of the tie bar shall be coated with epoxy. Epoxy shall be injected into the hole using a caulking gun or other approved method to fill the hole with epoxy. Epoxy injected shall be sufficient to fill the void between the bar and hole as evidenced by epoxy squeeze-out when the bar is inserted. Precautions shall be taken to prevent the tie bar from being disturbed until epoxy has sufficiently cured. Epoxy shall not be applied when the ambient temperature is below 40°F (5°C).

(g) Transverse Butt Joint (Type BJ): Transverse butt joints shall be constructed when extending existing pavement. Smooth dowel bars of the specified length, size, coating, spacing and material shall be placed perpendicular to transverse butt joints.

Dowel bars shall be installed in the existing pavement by drilling holes approximately 1/8-inch (3 mm) larger than the diameter of the bar. The bar shall be installed using an approved Type I, Grade C epoxy resin system. Holes shall be clean and moisture free.

The epoxy shall be mixed in accordance with the manufacturer's recommendations with no fillers or extenders added. The maximum quantity of epoxy, which may be mixed, is that quantity that can be applied within the manufacturer's designated time limit depending upon ambient temperature or other job conditions. The embedded surface of the dowel bar shall be coated with epoxy. Epoxy shall be injected into the hole using a caulking gun or other approved method to fill the hole with epoxy. Epoxy injected shall be sufficient to fill the void between the bar and hole as evidenced by epoxy squeeze-out when the bar is inserted. A grout retention ring shall be placed over the dowel bar against the slab face to prevent epoxy from flowing out of the hole. The grout retention ring shall be left in place. Precautions shall be taken to prevent bars from being disturbed until epoxy has sufficiently cured. Epoxy shall not be applied when the ambient temperature is below 40°F (5°C).

Transverse butt joints shall be formed by using a removable joint forming device after the concrete has been placed or by sawing in accordance with Heading (a)(1).

(h) Transverse Expansion Joints-Modified (Type EJ-Modified): Transverse expansion joints-modified shall consist of a 4-inch (100 mm) wide joint sawed over the bolster block. The bolster block shall be constructed from Class A concrete or one of the pavement types conforming to Section 901. One layer of tar paper equivalent to a minimum of 30 pounds per 100 square feet (15 kg per 9.0 sq m) shall be placed between the bolster block and the pavement. Joint material shall comply with Subsection 1005.06.

(i) 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 Subsection 1009.04.

Dowel bars may be placed by an approved mechanical device equipped with suitable means to control proper depth and alignment of the dowel bars. Dowel bars shall be positioned parallel to the pavement centerline and surface; and shall be firmly held in position by the mechanical device until concrete has been thoroughly consolidated around the bars.

Dowel bars placed in approved dowel assemblies shall have an approved expansion tube furnished with each bar used in expansion joints. The sleeve shall fit the dowel bar tightly and the closed end shall be watertight. The location of dowel bar placement for concrete shoulders shall conform to the plans.

Dowel bars with slightly damaged coatings may be used with the approval of the engineer provided the bars are lightly oiled or greased prior to placement.

(j) Asphaltic Concrete Overlaid Pavement: When new concrete pavement is to be overlaid with asphaltic concrete, joints shall be sawed or formed and sealed.

(k) Cracking: The intent of the specifications is for the contractor to construct concrete pavement free of longitudinal, transverse, and diagonal cracks. The contractor shall be responsible for repairing all longitudinal, transverse, and diagonal cracking that may occur. The contractor shall make immediate adjustments in his paving operations in order to prevent any additional cracking from occurring. Adjustments or modifications may include, but are not limited to, modifying sawing operations, applying bond breakers to base courses, lubricating dowel bars, reducing joint spacing, changing the cement-fly ash percentage, changing the cement-blast furnace slag percentage, changing the ratio of fine to coarse aggregates, changing aggregate gradation, and shortening or suspending paving operations when temperature changes occur. The cost of repairing all cracking and any adjustments in the contractor's paving operations, or concrete mixes to prevent cracking will be at no direct pay.

Cracking will be repaired by the following methods:

1) All transverse cracks shall be repaired with a full depth pavement patch.

2) All diagonal cracks shall be repaired with a full depth pavement patch.

3) All longitudinal cracks relatively parallel and within 8 inches (200 mm) of the longitudinal joint shall be repaired. The longitudinally sawed joint adjacent to the longitudinal cracks shall be cleaned and epoxied. The crack shall be routed, cleaned, and sealed unless otherwise directed by the engineer.

4) All longitudinal cracks farther than 8 inches (200 mm) from the longitudinal joint shall be repaired by a full depth pavement patch.

5) Multiple cracks per slab shall be repaired by replacing the entire slab between transverse joints.

The full depth pavement patching shall be placed in accordance with the details shown on the plans. Cracks to be sealed shall be routed to a minimum depth of 3/4 inch (20 mm) and to a width of not less than 3/8 inches (10 mm) or more than 5/8 inch (16 mm). The engineer may elect not to route and seal if the cracks are tight.

The concrete used for full depth pavement patching repair shall be the same type used throughout the project. If approved by the engineer, concrete for full depth patching can be substituted with Type E concrete. Spalls in the existing pavement resulting from pavement removal in the patch area shall be repaired by extending the removal limits to include the spalled areas. Pavement removal required for spall repair shall be the full lane width. Holes for dowel bars and tie bars shall be drilled into vertical faces of the adjoining pavement. Tie bars shall be installed in accordance with Subsection 601.09(f), and dowel bars shall be installed in accordance with Subsection 601.09(g). The finished patch surface shall meet the surface finish requirements of Subsection 601.11 and shall be textured to match the texture of the adjoining pavement.

Concrete used for panel replacement repair shall be the same type used throughout the project. If approved by the engineer, Class A concrete can be substituted for concrete used for panel replacement pavement repair.

601.10 CURING AND PROTECTION. Immediately after completion of finishing operations and as soon as marring of concrete will not occur, the pavement surface shall be cured by covering with a white pigmented curing compound. Concrete shall not be left exposed for more than 1/2 hour prior to applying the curing compound. Curing shall be maintained continuously for 72 hours.

(a) Curing: All exposed pavement surfaces shall be uniformly sprayed with white pigmented curing compound immediately after completion of surface finishing and as soon as surface water evaporates. Curing compound shall not be applied during rainfall.

Curing compound shall be applied under pressure by mechanical sprayers at the rate recommended by the manufacturer, but in no case less than 1 gallon per 100 square feet (4 L per 10 sq m) of surface area. Spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At time of use, the compound shall be thoroughly mixed. During application, the compound shall be stirred continuously by mechanical methods. Hand spraying of irregular widths or shapes and on surfaces exposed by form removal will be permitted provided curing compound has been thoroughly agitated prior to placing in the sprayer. Curing compound shall not be applied to inside faces of joints to be sealed. In split slab construction, curing compound shall be applied in such manner as to prevent spraying exposed tie bars.

Should the film become damaged within the curing period, the damaged portions shall be immediately repaired with additional compound.

When slip forming, or when the side forms are removed before the end of the 72-hour curing period, the exposed sides of slabs shall be immediately protected by applying a curing compound equal to that provided for the surface.

(b) Rain Protection: Prior to beginning daily paving operations, the contractor shall have available at the jobsite sufficient polyethylene sheeting material to properly protect the last 1 hour's operation against the effects of rain. The pavement surface and sides shall be covered with polyethylene sheeting, when required. Units shall be lapped at least 18 inches (450 mm). Sheeting shall be placed and weighted down so that it will remain in contact with the surface. Sheeting shall be large enough to extend beyond pavement edges at least twice the pavement thickness.

(c) Cold Weather Protection: When concrete is being placed and the air temperature is expected to drop below 35°F (2°C), a sufficient supply of straw, hay, grass, approved curing paper or other approved blanketing material shall be provided along the work. When the temperature is expected to reach the freezing point during the day or night, the protective material shall be spread over the pavement to a sufficient depth to prevent freezing of concrete. Concrete damaged by frost action shall be removed and replaced at no direct pay.

601.11 SURFACE TOLERANCE REQUIREMENTS (LONGITUDINAL).

(a) General: The pavement travel lanes will be tested using an approved California Type 25-Foot (7.5 m) Profilograph over each wheel path of each lane except that the outside wheel path will not be tested on projects which are classified in Table 601-1 as Category III projects and which have catch basins and curb along the outside edge of the pavement. The resulting profile trace will be evaluated to determine the location of high points (bumps) in excess of specification limits and to determine the pavement's Average Profile Index. The Average Profile Index is defined as the arithmetical average of the Profile Indexes of the wheel paths for each test section or lot of the travel lanes.

Associated pavements (acceleration lanes, deceleration lanes, continuous turn lanes and ramps) will be tested using the profilograph over the centerline of each lane or ramp. The resulting profile trace will be evaluated to determine the location of high points (bumps) in excess of specification limits.

Shoulders, turnouts, parking areas, crossovers and the 25-foot (7.5 m) areas of new travel lanes in tie-in areas shall be tested with an approved 10 foot (3.0 m) metal static straightedge.

The operation of the profilograph, including evaluation of the profile trace, determination of the Profile Index for each wheel path in each travel lane, calculation of the Average Profile Index for each roadway and determination of high points (bumps) in excess of specification limits shall be in accordance with DOTD TR 641. The operation of the profilograph and evaluation of the profile trace shall be by trained, qualified personnel who have successfully completed the Department's training and evaluation program.

The Blanking Band Template for determining the Profile Index shall be 0.2 inch (5 mm). The Bump Template for determining high points (bumps) in excess of specification limits shall be 0.3 inch in 25 feet (7.5 mm in 7.5 m) or less for Category I or II in Table 601-1 or 0.4-inch in 25 feet (10.0 mm in 7.5 m) or less for Category III in Table 601-1. The pavement profile determination will terminate approximately 25 feet (7.5 m) from each bridge approach slab or existing pavement that is joined by new pavement constructed under these specifications. Obviously deficient areas, as determined by the engineer, shall be corrected before any profilograph testing is performed.

(b) Requirements: Surface finish testing will be conducted in the longitudinal direction. Deficiencies shall be isolated in both the longitudinal and transverse direction. All pavement travel lanes and associated pavements, regardless of design speeds or paving operations, with surface deviations represented by high points (bumps) in excess of 0.3 inch in 25 feet (7.5 mm in 7.5 m) or less for Category I or II or 0.4 inch in 25 feet (10.0 mm in 7.5 m) or less for Category III shall be corrected.

A report as required in DOTD TR 641 of each profile trace performed by the contractor shall be submitted to the engineer for review.

(1) Design Speed Greater than 45 MPH (70 km/h): For pavements with design speeds greater than 45 mph (70 km/h), the contractor shall furnish paving equipment and employ methods that produce a riding surface having an Average Profile Index of not more than 6.0 inches per mile (94.5 mm/km) per lot.

(2) Urban Areas Using Continuous Paving Operations: For urban areas using continuous paving operations with design speeds 45 mph (70 km/h) or less, the contractor shall furnish paving equipment and employ methods that produce a riding surface having an Average Profile Index of not more than 12.0 inches per mile per lot (189.0 mm/km/lot).

(3) Urban Areas Not Using Continuous Paving Operations: For urban areas not using continuous operations (such as: areas with catch basins, manholes, crossovers, driveways, curb and gutter sections, and split-slab construction) with design speeds 45 mph (70 km/h) or less, the contractor

shall furnish paving equipment and employ methods that produce a riding surface having an Average Profile Index of not more than 20.0 inches per mile (315 mm/km) per lot.

(4) Tie-in Areas, Shoulders, Turnouts, Parking Areas, and Crossovers: For pavement tie-in areas, shoulders, turnouts, parking areas, and crossovers, the contractor shall furnish equipment and employ methods that produce an acceptable riding surface. Pavement tie-in areas with surface deviations in excess of 1/4 inch in 10 feet (5 mm in 3.0 m) shall be corrected. Pavement shoulders, turnouts, parking areas, and crossovers with surface deviations in excess of 1/2 inch in 10 feet (15 mm in 3.0 m) shall be corrected.

(c) Equipment: The profilograph used for daily paving quality control and to identify surface areas requiring corrective actions shall consist of an approved California Type 25-foot (7.5 m) Profilograph furnished and operated by the contractor, calibrated and operated in accordance with DOTD TR 641.

The profilograph used for surface tolerance acceptance and to determine surface finish payment adjustments shall consist of an approved California Type 25-Foot (7.5 m) Profilograph furnished, calibrated and operated by the Department in accordance with DOTD TR 641.

The pavement profile is recorded by the profilograph at a scale of 1:1 vertically and 1:300 [1 inch equals 25 feet (25 mm equals 7.5 m)] longitudinally.

An approved 10-foot (3.0 m) metal static straightedge shall be furnished by the contractor for both quality control and acceptance surface tolerance testing of tie-in areas, shoulders, and turnouts, parking areas, and crossovers.

(d) Quality Control Surface Testing: The contractor shall perform quality control surface testing to ensure his paving and finishing operations are producing pavements meeting the requirements for all pavement types listed under the heading. The testing shall be performed using the equipment and at intervals listed under each pavement type.

(1) Pavement Travel Lanes: During the start up of initial paving operations, or after a shut down period, initial surface testing shall be performed by the contractor with a profilograph as soon as the concrete has cured sufficiently to allow testing. The purpose of this initial testing is to aid the contractor and the Department in evaluating the paving operations and equipment. The results from this testing shall be furnished to the engineer prior to proceeding with paving operations. If initial testing and evaluation indicates that the Average Profile Index exceeds the minimum requirements given in Table 601-1 for payment, paving operations shall be suspended until the contractor makes alterations to the paving and finishing operation in order to produce pavements within these limits. The contractor shall continue initial

surface testing and make changes to his paving operations until he has demonstrated that he can pour pavements within surface tolerance limits. After initial surface testing has demonstrated that paving operations and pavement smoothness are acceptable, the contractor shall proceed with regular paving operations and the contractor shall test each days paving with the profilograph no later than during the first work day following placement of the pavement. If the contractor fails to meet the minimum requirements given in Table 601-1 during regular paving operations, work shall be stopped and alterations to the paving and finishing operation shall be made by the contractor before paving operations can continue. The contractor shall also perform surface testing at the time interval specified for initial surface testing until the engineer is satisfied that the pavement is meeting minimum surface tolerance requirements.

Areas with high points (bumps) in excess of the requirements given in Heading (b), shall be isolated both longitudinally and transversely and corrected by the contractor for the full longitudinal and transverse extent of their occurrence in accordance with Heading (d)(5). Additional profiles as necessary shall be taken by the contractor to define the limits of all out of tolerance pavement requiring correction.

After correcting all individual deviations in excess of the requirements in Heading (b), additional corrective action shall be made by the contractor as necessary to reduce the Average Profile Index to the minimum requirements given in Table 601-1. Corrections shall be made in accordance with Heading (d)(5).

On those areas where corrective action is taken, the pavement shall be reprofiled as many times as necessary by the contractor to verify that corrections have produced an Average Profile Index that complies with the minimum requirements given in Table 601-1 and that the surface deviations in excess of the requirement given in Heading (b), have been corrected.

(2) Associated Pavement: During the start up of initial paving operations or after a shut down period, initial surface testing shall be performed by the contractor with a profilograph as soon as the concrete has cured sufficiently to allow testing. The purpose of this initial testing is to aid the contractor and the Department in evaluating the paving operations and equipment. The results from this testing shall be furnished to the engineer prior to proceeding with paving operations. If initial testing and evaluation indicates that there are excessive high points (bumps) in excess of the requirements given in Heading (b), the contractor shall stop and alter paving operations to reduce or eliminate the number of high points (bumps) in excess of specification limits. After initial surface testing has demonstrated that

paving operations and pavement smoothness are acceptable, the contractor shall proceed with regular paving operations, and the pavement shall be tested with a profilograph after paving operations for the associated pavement have been completed.

High points (bumps) having deviations in excess of the requirements given in Heading (b) shall be isolated and corrected by the contractor for the full longitudinal and transverse extent of their occurrence in accordance with Heading (d)(5). Verification of the required correction by reprofiling shall be conducted by the contractor.

(3) Shoulders, Turnouts, Parking Areas, and Crossovers: During the start up of initial paving operations, or after a shut down period, initial surface testing shall be performed by the contractor with an approved 10-foot (3.0 m) metal static straight edge as soon as the concrete has cured sufficiently to allow testing. The purpose of this initial testing is to aid the contractor and the Department in evaluating the paving operation and equipment. The results from this testing shall be furnished to the engineer prior to proceeding with paving operations. If initial testing and evaluation indicates surface deviations in excess of 1/2 inch in 10-foot (15 mm in 3.0 m), the contractor shall stop and alter paving operations to produce pavement with surface deviations of 1/2 inch or less in 10 feet (15 mm or less in 3.0 m). After initial surface testing has demonstrated that paving operations and pavement smoothness are acceptable, the contractor shall proceed with regular paving operations. The pavement shall be tested with a 10-foot (3.0 m) metal straight edge after paving operations for this pavement type have been completed.

Surface deviations in excess of 1/2 inch in 10 feet (15 mm in 3.0 m) shall be isolated and corrected by the contractor for the full longitudinal and transverse extent of their occurrence in accordance with Heading (d)(5).

(4) Tie-in Areas: Initial surface testing will not be required for tie-in areas, however, the contractor shall alter his paving operations if the surface tolerance at the tie-in is unacceptable to the engineer.

The surface of the 25-foot (7.5 m) areas of pavement in tie-in areas which are not tested with the profilograph shall be tested after completion in each wheel path for its entire length with a 10-foot (3.0 m) metal static straight edge. The joint between the new and existing pavement or approach slab shall also be tested with the straight edge placed longitudinally across the joint in each wheel path. Surface deviations in excess of 1/4 inch in 10 feet (6 mm in 3.0 m) shall be isolated and corrected by the contractor for the full longitudinal and transverse extent of their occurrence in accordance with Heading (d)(5).

(5) Corrections: Corrections shall be made using an approved profiling device or by removing and replacing the pavement as directed. The use of bush hammers or other impact devices will not be permitted. In cases where corrections are made using an approved profiling device the contractor shall reestablish transverse grooving by sawing to provide a uniform texture conforming to Subsection 601.08(h). Corrective work will be at no direct pay and shall be completed prior to determination of pavement or shoulder thickness.

(e) Acceptance Surface Testing:

(1) Travel Lanes: After corrective work and verification within a lot has been completed by the contractor in conformance with these specifications, each lot will be tested for surface tolerance acceptance. The acceptance testing for surface tolerance will be performed by the Department unless the contractor requests to do the testing. If the contractor elects to do the testing, all final quality control traces including any "reroll" quality control trace shall be run in the presence of a DOTD Authorized Profilograph Operator or Evaluator and the Department will take immediate possession of these traces for evaluation by the DOTD Authorized Evaluator. Use of the contractor's profilograph profile trace for acceptance shall be in accordance with TR 641, and testing shall be performed using the pavement lot limits determined by the Department. To determine surface tolerance payment adjustments, the Profile Index will be determined in each wheel path of each travel lane, the Average Profile Index will be calculated and any high points (bumps) in excess of specification limits will be identified. When high points (bumps) are found in excess of the requirements given in Heading (b), the contractor shall make corrections in accordance with Heading (d)(5). The entire lot, except for the exceptions at approach slabs and adjacent to existing pavement tie-ins, will be tested and evaluated.

(2) Associated Pavement: After corrective work and verification within a lot has been completed by the contractor in compliance with these specifications, each lot will be tested at the centerline of the pavement for surface tolerance acceptance. Ramps which have a centerline joint will be treated as having two lanes. The acceptance testing for surface tolerance will be performed by the Department unless the contractor requests to do the testing. Use of the contractors' profilograph profile trace for acceptance shall be in accordance with TR 641, and shall be performed using the pavement lot limits determined by the Department. High points (bumps) found in excess of the requirements given in Heading (b) shall be corrected by the contractor in accordance with Heading (d)(5). All associated pavement shall be tested

except for the exceptions at approach slabs and adjacent to existing pavement tie-ins.

(3) Shoulders, Turnouts, Parking Lots, and Crossovers: After corrective work has been completed, the surface of shoulders, turnouts and crossovers will be tested longitudinally by the engineer at one randomly selected location in each 300 linear feet (90 lin m) using the straightedge. Areas with surface deviations of 1/2 inch in 10 feet (15 mm in 3.0 m) will be isolated by the engineer and shall be corrected by the contractor at no direct pay to within 1/2 inch (15 mm) deviation in accordance with Heading (d)(5).

(4) Tie-in Areas: After corrective work has been completed, the surface of the 25-foot (7.5 m) area of new pavement adjacent to tie-ins with existing pavements or approach slabs which is not tested with the profilograph will be tested in each wheel path for its entire length with an approved 10-foot (3.0 m) metal static straightedge. The joint between the new and existing pavement or approach slab will also be tested with the straightedge placed longitudinally across the joint in each wheel path. Surface deviations in excess of 1/4-inch in 10 feet (5 mm in 3.0 m) will be isolated by the engineer and shall be corrected by the contractor in accordance with Heading (d)(5).

(5) Corrections: If the Department determines the Average Profile Index for pavement travel lanes does not conform to the specification requirements for 100 percent payment, given in Table 601-1, the contractor will be allowed to make corrections in accordance with Heading (d)(5) and the Department will reprofile for acceptance one additional time.

The engineer will review the profile trace on a per lot basis. Those areas out of specification which have been, in the opinion of the engineer, created by conditions beyond the control of the contractor may be isolated and excluded from the calculations of the average profile index. These exceptions may involve manholes and other structures located in the roadway, grade changes at intersections, and other specific conditions which cause abrupt deviations in the profile trace. High points (bumps) shall be corrected in accordance with Heading (d)(5).

601.12 REMOVING FORMS. Forms shall not be removed from freshly placed concrete until it has achieved final set. Forms shall be removed carefully to avoid damage to pavement. After forms are removed, sides of the slab shall be cured in accordance with Subsection 601.10. Minor honeycombed areas shall be filled with mortar composed of one part cement and two parts fine aggregate. Major honeycombed areas shall be removed and replaced. Any area or section so removed shall not be less than 10 feet (3.0 m) in length nor less than the full width of the lane involved. When it is

necessary to replace a section of pavement, any remaining portion of the slab adjacent to joints that is less than 10 feet (3.0 m) long shall also be replaced.

601.13 SEALING JOINTS.

(a) General Requirements: Each joint will be subject to approval for proper width, depth, alignment and preparation before sealing. Sealing of joints will be required when concrete is to be overlaid with asphaltic concrete.

Pavement may be opened to traffic prior to sealing provided the joint forming device or insert has not been removed or sawed. When the insert is removed or sawed, pavement may be opened to traffic provided joints are protected during the interval between sawing and sealing. Protection of joints shall be accomplished by placement of a backer material immediately after sawing or removal of insert. When poured or extruded sealants are used, the concrete shall be at least 7 days old prior to sealing joints. When opening sections to traffic and when poured or extruded sealants are used, joints in pavement gaps, tie-ins, and other areas approved by the engineer can be sealed after three days provided the concrete has attained a compressive strength of 3,000 psi (20.7 MPa).

Joints shall be thoroughly cleaned immediately prior to sealing. Poured or extruded sealants require joint faces to be sandblasted immediately prior to sealing. Sandblasting is not required for preformed elastomeric compression seal except when the joint insert is sawed.

Sealant shall be placed as soon as possible after curing of concrete. Traffic will not be permitted while sealing and until after sealant is cured. When a poured or extruded sealant in accordance with Subsection 1005.02 is used, the pavement shall be closed to traffic for at least one day after sealing. When elastomeric compression seal is used, the pavement may be opened to traffic immediately following completion of sealing.

Joints shall be free of spalls, fractures, breaks or voids. Areas requiring repairs shall be chipped back to sound concrete and repaired with an approved nonshrinking patching system in accordance with the manufacturer's recommendations.

Joint sealants shall be installed in accordance with the manufacturer's recommendations. Sealants shall comply with the following:

(1) Longitudinal joints (Type LJ) shall be sealed as specified in Subsection 601.09(a).

(2) Transverse expansion joints (Type EJ) shall be sealed as specified in Subsection 601.09(b).

(3) Transverse contraction (Type TCJ) and construction joints (Type CJ) shall be sealed with either silicone polymers complying with

Subsection 1005.02(c), preformed elastomeric joint sealer complying with Subsection 1005.03(a), or combination joint former/sealers complying with Subsection 1005.04.

(4) Longitudinal and transverse joints to be overlaid with asphaltic concrete with any sealant complying with Subsection 1005.02.

(5) Transverse expansion joints, (Type EJ Modified), 4 inches (100 mm) sealed with a preformed polyurethane foam sealant complying with Subsection 1005.06.

(6) Transverse butt joints (Type BJ) shall be sealed with either silicone polymer complying with Subsection 1005.02(c) or preformed elastomeric joint seal complying with Subsection 1005.03(a).

(7) Transverse expansion joints (Type EJ Modified), 1 1/2 inch (38 mm) shall be sealed with sealant complying with Subsection 1005.02(d) or 1005.03.

(8) Longitudinal joints in the asphaltic concrete shoulders adjacent to concrete pavement shall be sawed in accordance with plan details and sealed with a sealant complying with Subsection 1005.02(a).

Transverse shoulder and roadway joints shall be sealed with the same sealant.

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

(1) Hot Poured Rubberized Asphaltic Sealants:

a. Joint Preparation: Joints shall be formed or sawed in accordance with Subsection 601.09. Joints shall be thoroughly cleaned by sandblasting to effectively remove concrete curing membrane, laitance and other foreign matter from the joint. Sandblasting operations shall continue until the joint exhibits a uniformly etched surface. Upon completion of sandblasting, the joint and adjacent areas shall be dry and cleaned of dust and sand.

b. Application: Poured sealants and backer material complying with Subsections 1005.02(a) shall be installed in accordance with the following requirements.

The sealant shall not be installed until the joint has been approved. A backer material complying with Subsection 1005.02 shall be placed as shown on the plans. The joint shall be sealed without formation of entrapped air or voids. Air temperature at the time of installation shall be at least 50°F (10°C).

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 (195°C to 210°C) will be required. Kettles shall have easy access to facilitate cleaning. They shall be thoroughly cleaned of foreign substances or previously used compounds and shall be flushed daily with flushing oil. This equipment shall be provided with an automatic continuous temperature recording chart for constant kettle temperature surveillance. A direct connecting pressure-type extruding device with nozzles shaped for insertion into the joint shall be provided. Application equipment shall be so designed that sealant material may be recirculated 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.

(2) Preformed Elastomeric Compression Seals: Preformed elastomeric compression seals shall comply with Subsection 1005.03. When the adhesive-lubricant material is to be pumped, a maximum of 30 percent dilution with a material recommended by the manufacturer will be allowed. The adhesive-lubricant shall be applied just prior to installation of the seal and shall be sufficient to completely cover the seal's sidewalls.

Seals shall be installed by machine on projects requiring 3,000 feet (900 m) or more of joint sealing. Stretching of the compression seal shall not exceed 5 percent. Prior to beginning installation, a length of seal equal to the pavement width shall be cut and installed so that stretching may be measured. Random checks for stretching shall be made as deemed necessary by the engineer. If the adhesive-lubricant has chemically set and maximum stretch limits are exceeded, the seal shall be removed and cleaned, the joint recleaned and the seal reinstalled. Field splicing will not be allowed.

(3) Silicone Sealant: The silicone sealant shall comply with Subsection 1005.02(c) or 1005.02 (d). The sandblasted joint faces shall be dry and dust free prior to sealant installation. The air temperature at the time of placement shall be at least 50°F (10°C) and rising. Backer material complying with Subsection 1005.02 shall be placed as shown in the plans. The joint faces shall be primed in accordance with the manufacturer's recommendations when a silicone sealant conforming to Subsection 1005.02(d) is used.

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

(4) Preformed Polyurethane Foam: Preformed polyurethane foam shall comply with Subsection 1005.06. Preformed polyurethane foam shall be installed using an approved, moisture insensitive lubricant-adhesive according to manufacturers' instructions.

601.14 PROTECTION OF PAVEMENT. The contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the contractor's employees and agents. This shall include flaggers to direct traffic, and erection and maintenance of warning signs, lights, pavement bridges or crossovers, etc., as necessary.

Any damage to pavement occurring prior to final acceptance shall be repaired or the pavement replaced at no direct pay.

601.15 SPLIT SLAB CONSTRUCTION. Split slab construction methods will only be permitted with the written approval of the DOTD Chief Construction Engineer when required for traffic maintenance, for short pavement sections or for turnouts, crossovers and other irregular sections.

There will be no additional payment for split slab construction. Longitudinal joints in pavement constructed by the split slab method shall comply with Subsection 601.09(a). Pavement constructed by this method shall in all other respects conform to these specifications. Split slabs placed with slip-form pavers shall conform to Subsection 601.16.

The use of split slab construction methods will not preclude the use of approved paving equipment as specified elsewhere herein.

601.16 SLIP FORM PAVING METHOD. The slip-form paving method may be used at the option of the contractor.

(a) Grade and Alignment: After the grade or base has been placed and compacted to required density, areas which will support the paving machine shall be cut to required elevation by means of a properly designed machine. The requirements of Subsection 601.04 shall apply for preparing and maintaining the grade during paving operations. The slip-form paver shall have the capability of maintaining correct alignment and grade. Edge lines shall not deviate from true alignment by more than 1/2 inch (15 mm) at any point.

(b) Placing Concrete: Concrete shall be placed with an approved slipform paver designed to spread, consolidate, screed and float-finish freshly placed concrete in one pass of the machine in such manner that a minimum of hand finishing will be necessary to provide a dense, homogeneous pavement in conformance with plans and specifications. The machine shall be equipped with vibrators conforming to Subsection 601.03(a). Concrete shall be vibrated for the full pavement width and depth. Sliding forms shall be rigidly held together laterally to prevent spreading of forms.

Concrete shall be of a uniform consistency exhibiting minimal bleed water and laitance. The slip-form paver shall be operated with as nearly a

continuous forward movement as possible. Mixing, delivering and placing concrete shall be coordinated 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 (450 mm) per minute. If it is necessary to stop forward movement of the paver, the vibrator and tamping elements shall also be stopped immediately. If forward movement of the paver is delayed for a period of time, the engineer may direct fogging of the pavement. No tractive force shall be applied to the machine except that which is controlled from the machine.

(c) Finishing: Pavement finishing and texturing shall conform to Subsection 601.08. Surface tolerances shall be as specified in Subsection 601.11 with the following modifications. In addition to longitudinal testing, edges of slabs placed without conventional forms shall conform to the following tolerances when tested transversely with an approved 5-foot (1.5 m) metal static straightedge.

(1) Edges not along Longitudinal Joints: The following edge slump tolerance will only be allowed within a 6 inches (150 mm) width adjacent to the pavement edge. The surface within the 6 inches (150 mm) width adjacent to the edge shall not vary more than 1/2 inch (13 mm). The pavement edge shall be checked by the contractor with a 5 foot (1.5 m) straight edge while the concrete is still in a plastic state. Any edge slump settlement in excess of 1/2 inch (13 mm) shall be corrected before the concrete has hardened. If the 1/2-inch (13 mm) tolerance is not being met, conventional metal forms shall be placed at the slab edges. Top of the forms shall be set to required grade, and the forms shall be adequately supported to maintain required line and grade during concrete placement and finishing operations.

If edge slump deficiencies are not corrected by the method described above before the concrete has hardened, then the following method of correction shall apply. Areas that fail to meet the required edge slump tolerance shall be removed by full depth sawing of the pavement edge for a minimum width of 12 inches (300 mm) and repoured to the original lane width at proper grade. An approved Type II, Epoxy, Grade B or Grade C listed under QPL 32 shall be applied to the vertical faces, and tie bars shall be installed in the original slab in accordance with the plans, prior to repouring the pavement edge. The minimum length of removal for edge slump corrections shall be 10 feet (0.3 m).

(2) Edges at Longitudinal Joints: The following edge slump requirements will only be allowed within a 6-inch (150 mm) width adjacent to the pavement edge, and it will apply to all locations where additional concrete

work (additional lanes, shoulders, turnouts, ramps, widening, curb and gutters, etc.) is to be constructed immediately adjacent to the pavement being placed. The surface within the 6-inch (150 mm) width adjacent to the edge shall not vary more than 1/4 inch (6 mm). The pavement edge shall be checked by the contractor with a 5-foot (1.5 m) straight edge while the concrete is still in a plastic state. Any edge slump settlement in excess of 1/4 inch (6 mm) shall be corrected before the concrete has hardened. If the 1/4 inch (6 mm) tolerance is not being met, conventional metal forms shall be placed at the slab edges. Top of the forms shall be set to required grade, and the forms shall be adequately supported to maintain required line and grade during concrete placement and finishing operations.

If the edge slump deficiencies are not corrected by the method described above before the concrete has hardened, then the following method of correction shall apply. Areas that fail to meet the required edge slump tolerance shall be corrected by full depth removal of the pavement edge and replacing it as part of the adjacent concrete work. The pavement shall be removed by full depth sawing for a width necessary to bring the pavement within the required tolerance. The maximum width that may be removed and replaced with the adjacent concrete work is 12 inches (300 mm). If the pavement surface corrections require removing more than 12 inches (300 mm) of the pavement edge, full depth removal will be required for one-half of the lane width. The one-half lane pavement removal shall be replaced in accordance with the Departments' full depth concrete pavement patching details prior to placing the adjacent paving. All removals for edge slump corrections shall begin and end at a transverse joint.

(d) Curing: Curing shall be done in accordance with Subsection 601.10.

(e) Joints: Joints shall be constructed and sealed in accordance with Subsections 601.09 and 601.13.

(f) Rain Protection: The contractor shall have adequate materials available for protection of edges and surface of unhardened concrete from damage due to rain prior to each days paving. Such protective materials for pavement edges shall consist of standard metal forms or wood planks having a nominal thickness of 2 inches (50 mm) and a nominal width of not less than the pavement thickness. Protective materials for pavement surfaces shall comply with Subsection 601.10(b). When rain appears imminent, paving operations shall stop and all available personnel shall begin placing forms against pavement edges and covering the surface of the unhardened concrete with polyethylene sheeting.

(g) Cold Weather Protection: Cold weather protection shall comply with Subsection 601.10(c).

601.17 OPENING TO TRAFFIC. The pavement shall not be opened to any traffic, including vehicles of the contractor, until standard test specimens complying with Subsection 601.07 have attained a compressive strength of 3,000 psi (20.7 MPa) when tested in accordance with DOTD TR 230. If the compressive strength tests are not conducted, the pavement shall not be opened to traffic until 14 days after concrete has been placed. The pavement shall be cleaned and joints sealed in accordance with Subsection 601.13 prior to opening to traffic.

601.18 ACCEPTANCE REQUIREMENTS.

(a) General: Sampling and testing for acceptance will be conducted on each lot of pavement for thickness, compressive strength and surface tolerance. Any pavement that is obviously deficient shall be satisfactorily corrected or removed and replaced. Sampling and testing shall be accomplished following a stratified sampling plan in accordance with the Materials and Sampling Manual and specified test procedures. Times and locations will be established by the engineer.

A lot of portland cement concrete pavement or shoulders is an identifiable area of approximately 4000 square yards (4000 sq m) paid under the same item. The final area of pavement placed will be considered as a lot if it is at least 2000 square yards (2000 sq m); 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 on each lot for acceptance provided the same lot sizes are maintained.

(b) Thickness and Compressive Strength: Strength and thickness of pavements will be determined from hardened cores. Concrete core location, diameter, thickness and strength determinations will be made by the Department in accordance with DOTD TR 225. The contractor, in the presence of a DOTD District Laboratory representative, shall cut the cores and the DOTD representative shall take immediate possession of the cores. The contractor shall notify the District Laboratory Engineer at least five (5) days prior to the start of coring operations.

Each pavement lot will be divided into five (5) equal segments and one core will be obtained from each segment after surface tolerances have been met. Additional cores required by the Department to isolate thickness, strength or other pavement deficiencies, or recutting deficient cores will be done at no direct pay. All core holes in the pavement shall be patched by the contractor using an approved pavement or structural concrete mixture meeting the requirements of Section 901. The core holes are to be patched immediately after coring operations for each construction phase are completed. The surface

of the patch shall be finished to match the surrounding pavement. The cost of patching the core holes will be included in the bid price of the concrete coring.

(1) Thickness: The average thickness of the pavement lot shall not be less than the specified thickness by more than 0.10 inch (3 mm). Under thickness deficiencies in excess of 0.10 inch (3 mm) will be subject to the payment adjustments shown in Table 601-1. Over thickness will be waived at no direct pay.

In calculating average pavement thickness, individual measurements in excess of specified thickness by more than 0.25 inch (6 mm) will be considered as specified thickness plus 0.25 inch (6 mm).

Individual areas found deficient in thickness by more than 1 inch (25 mm) will be evaluated by the engineer, and if in the engineer's judgment the deficient areas warrant removal, they shall be removed and replaced with concrete of specified thickness. If the deficient area is allowed to 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 made in accordance with Table 601-1 based on the average thickness of the remaining lot segments.

(2) Compressive Strength: Average compressive strength for the lot shall not be less than 4,000 psi (27.6 MPa) or 3,600 psi (24.9 MPa) when air entrainment is used.

When the average strength for the lot is less than 4,000 psi (27.6 MPa), 3,600 psi (24.9 MPa) when air entrainment is used, the contract unit price will be adjusted in accordance with Table 601-1. When an individual core indicates compressive strength less than 3,000 psi (20.7 MPa), and if in the judgment of the engineer 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 601-1 based on the average compressive strength of the remaining segments. If removal is warranted, the entire deficient section shall be replaced with concrete of the specified quality.

The compressive strength of cores will be determined after a minimum of 28 days.

(3) Projects with less than 2,000 square yards (2,000 sq m): Projects with less than 2,000 square yards (2000 sq m) of pavement may be cored as required in Headings (1) and (2) above, or may be accepted on the basis of compressive strength cylinders and thickness measurements taken by the engineer.

(c) Surface Tolerance: The surface of each pavement lot will be tested longitudinally with an approved profilograph as described in Subsection

601.11. If sections of pavement do not meet the requirements for surface tolerance, an adjustment in unit price for the lot will be made in accordance with Table 601-1. There is no payment adjustment for associated pavements, tie-in areas, shoulders, turnouts, crossovers, and parking areas.

601.19 QUALITY CONTROL. The contractor shall be responsible for the production, transporting, placement, joint construction, surface finishing, maintenance and curing of all concrete pavement and shoulders constructed in accordance with these specifications. The contractor shall control the work to produce concrete pavement and shoulders that are uniform and conform to the plan dimensions and test requirements. The contractor shall perform whatever tests are necessary to ensure the concrete pavement and shoulders comply with these specifications. Construction methods shall be such that cracking does not occur.

601.20 MEASUREMENT. The quantities of portland cement concrete pavement for payment will be the design quantities specified in the plans and adjustments thereto. Design quantities will be adjusted if the engineer makes changes to adjust to field conditions, if plan errors are proven, or if design changes are necessary. Design areas of pavement are based on the horizontal dimensions shown on the plans, the length being along the centerline of the pavement.

601.21 PAYMENT. Payment for portland cement concrete pavement will be on a lot basis at the contract unit price per square yard (sq m), which includes furnishing and placing all materials including tie bars, dowel bars and joint material. Concrete cores taken for thickness and strength acceptance will be paid at the contract unit price per each. There will be no adjustment in the unit price for coring when different pavement thicknesses are specified. If the pavement does not comply with acceptance requirements, payment will be made at an adjusted unit price in accordance with Table 601-1. When payment adjustments are made for more than one deficiency, they shall be cumulative.

Payment will be made under:

Item No.	Pay Item	Pay Unit
601-01	Portland Cement Concrete Pavement ___in. (mm) Thick	Square Yard (Sq m)
601-02	Portland Cement Concrete Pavement (Crossovers and Turnouts) ___in. (mm) Thick	Square Yard (Sq m)
601-03	Portland Cement Concrete Shoulder ___in. (mm) Thick	Square Yard (Sq m)
601-04	Portland Cement Concrete Pavement Coring	Each

Table 601-1E
Payment Adjustment Schedule

	Payment (Percent Of Contract Unit Price/Lot)[1]					
	100	98	95	80	50 or remove and replace[2]	Correct or remove and replace[2]
Deficiency in Average Thickness of 5 cores per lot, inches	0 to 0.10	-----	0.11 to 0.25	0.26 to 0.50	Over 0.50	-----
Average Compressive Strength, psi						
Without Air Entrainment	4000 & over	-----	3500 to 3999	3000 to 3499	Below 3000	-----
With Air Entrainment	3600 & over	-----	3150 to 3599	3000 to 3149	Below 3000	-----
Category I Average Profile Index (inches/mile/lot) for pavement travel lanes with design speed greater than 45 mph[3]	6.0 or less	6.1 to 7.0	7.1 to 8.0	-----	-----	over 8.0
Category II Average Profile Index (inches/mile/lot) for Urban Areas using continuous paving operations with design speeds 45 mph or less[3]	12.0 or less	12.1 to 13.0	13.1 to 14.0	-----	-----	over 14.0
Category III Average Profile Index (inches/mile/lot) for Urban Areas not using continuous paving operations with design speeds 45 mph or less[3]	20.0 or less	20.1 to 22.0	22.1 to 24.0	24.1 to 26.0	-----	over 26.0

[1]Payment adjustments shall be cumulative.
[2]At the option of the Department after investigation.
[3]As defined in Subsection 601.11 using an approved profilograph.

Table 601-1M
Payment Adjustment Schedule

	Payment (Percent of Contract Unit Price/Lot)[1]					
	100	98	95	80	50 or remove and replace[2]	Correct or remove and replace[2]
Deficiency In Average Thickness of 5 cores per lot, mm	0 to 3	-----	4 to 6	7 to 13	Over 13	-----
Average Compressive Strength, MPa						
Without Air Entrainment	27.6 & over	-----	24.1 to 27.5	20.7 to 24.0	Below 20.7	-----
With Air Entrainment	24.9 & over	-----	21.7 to 24.8	20.7 to 21.6	Below 20.7	-----
Category I Average Profile Index (mm/km)/lot for pavement travel lanes with design speed greater than 70 km/h[3]	94 or less	95 to 110	111 to 126	-----	-----	Over 126
Category II Average Profile Index (mm/km)/lot for Urban Areas using continuous paving operations with design speeds 70 km/h or less[3]	189 or less	190 to 205	206 to 221	-----	-----	Over 221
Category III Average Profile Index (mm/km)/lot for Urban Areas not using continuous paving operations with design speeds 70 km/h or less[3]	315 or less	316 to 347	348 to 378	379 to 410	-----	Over 410

[1]Payment adjustments shall be cumulative.
[2]At the option of the Department after investigation.
[3]As defined in Subsection 601.11 using an approved profilograph.

Section 602
Portland Cement Concrete Pavement Rehabilitation

602.01 DESCRIPTION. This work consists of the repair and rehabilitation of portland cement concrete pavements, which includes pavement grinding and texturing, retrofitting 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.

Removed materials, including concrete pavement, shall be disposed of outside the project rights-of-way in accordance with Subsection 202.02.

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".

602.02 MATERIALS. Materials for concrete pavement rehabilitation shall comply with the requirements of the appropriate subsection. Materials necessary for performing the work shall be approved by the engineer.

602.03 EQUIPMENT. Equipment for concrete pavement rehabilitation shall conform to the requirements of the appropriate subsection. Equipment and tools necessary for handling materials and performing the work will be approved by the engineer. The equipment shall be at the job site sufficiently ahead of the start of operations to be examined for approval.

602.04 CLEANING AND FILLING EXISTING LONGITUDINAL PAVEMENT JOINTS. This work consists of removing joint sealants in longitudinal joints, 2 inches (50 mm) and wider, in existing concrete pavement and filling the joints in accordance with plan details and the following requirements.

Joints and adjacent pavement surfaces shall be cleaned of existing sealants, incompressibles and debris to the satisfaction of the engineer in accordance with the plans. Joint faces shall then be cleaned by sandblasting or water blasting, and blown free of sand or water by compressed air just prior to filling. The air compressor shall be equipped with an approved oil and water trap. The joints shall be dry before filling. Prepared joints shall be filled within 24 hours. Joints that have become contaminated or dirty before filling

shall be recleaned as directed.

The joints shall be filled 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 A complying with Section 1017. The fine aggregate shall consist of packaged concrete or mortar sand complying with Section 1003 with the additional requirement that the sand, just prior to mixing, shall be in an oven dry 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. The dry aggregate shall be stored and proportioned so as to yield a uniformly combined material. The epoxy resin system and fine aggregate shall be mixed in equipment and by methods that produce a homogenous mixture.

Reinforcing steel shall be placed in the joint as shown on the plans. The reinforcing shall be cut at transverse joints. Transverse joints shall be established in the epoxy concrete by using inserts or sawing, and then sealed.

Existing transverse joints shall be protected from intrusion of epoxy concrete. If epoxy concrete gets into the transverse joints they shall be immediately cleaned 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. This work consists of removing joint sealants in longitudinal and transverse joints of existing concrete pavement and resealing the joints in accordance with plan details and the following requirements.

Joints and adjacent pavement surfaces shall be cleaned of existing sealants, incompressibles and debris in accordance with the plans to the satisfaction of the engineer. Joint faces shall be cleaned by sandblasting or water blasting, and blown free of sand or water by compressed air just prior to resealing. A minimum of one pass with the blasting nozzle held at an angle close to the surface [1-2 inches (25-50 mm)] shall be made along each reservoir face. The air blowing operation is to proceed in one direction (forward) to prevent recontamination of the joint. The air compressor shall be equipped with an approved oil and water trap. The joint shall be dry before resealing. Prepared joints shall be resealed within 24 hours. Joints, which have become contaminated or dirty before resealing, shall be recleaned as directed.

Resealing materials shall comply with Subsection 1005.02(a), and be

installed in accordance with plan details and the manufacturer's recommendations. Backer material shall be of the size shown on the plans complying with Subsection 1005.02(a).

Small crushed corners, not repaired by other methods, shall be sealed with hot poured sealant at the same time the joint is sealed to the satisfaction of the engineer at no direct pay.

The resealed joint shall remain closed to traffic until, in the engineer's opinion, the sealant has satisfactorily cured to tack free.

602.06 CLEANING AND SEALING CRACKS. This work consists of cleaning and sealing longitudinal, diagonal, and transverse cracks in accordance with plan details and the following requirements. The minimum width of crack to be sealed shall be 3/8-inch (10 mm) at the pavement surface. Cracks to be sealed shall be designated by the engineer.

Cracks shall be cleaned by sandblast or water blast. Cracks, less than 1/2 inch (13 mm) wide shall be routed to form a sealant reservoir approximately 1/2 inch (13 mm) wide by 1/2 inch (13 mm) deep and blown free of sand or water by compressed air just prior to sealing. A minimum of one pass with the blasting nozzle held at an angle close to the surface [1 - 2 inches (25 - 50 mm)] shall be made along each reservoir face. The air blowing operation is to proceed in one direction (forward) to prevent recontamination of the joint. The air compressor shall be equipped with an approved oil and water trap. The crack shall be dry before sealing. Prepared cracks shall be sealed within 24 hours. Cracks, which have become contaminated before sealing, shall be recleaned as directed. Cracks shall be sealed with a hot poured sealant complying with Subsection 1005.02(a), installed in accordance with the manufacturer's recommendations.

The sealed cracks shall remain closed to traffic until, in the engineer's opinion, the hot poured sealant has satisfactorily cured to tack free.

602.07 FULL DEPTH CORNER PATCHING OF JOINTED CONCRETE PAVEMENT. This work consists of full-depth removal and replacement of portland cement concrete pavement corner breaks at locations shown on the plans or as directed, in accordance with plan details and the following requirements.

Unsound concrete within the patch area shall be removed with approved pneumatic tools having a maximum weight of 30 pounds (14 kg). Any other method of removal shall be approved by the engineer. This approval is subject to the contractor demonstrating satisfactory performance without damage to the base course.

Before placing concrete, existing joints within or adjacent to patch areas shall be sawed to provide for the placement of fiberboard or other approved material in the joint. The fiberboard shall extend for the full thickness of the pavement.

Concrete surfaces within the patch area shall be cleaned of loose particles, dust and debris, and a bonding grout shall be applied 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 (mass) with enough water to provide a stiff slurry. Grout shall be continuously agitated, and shall be used within 90 minutes.

Deteriorated base course in the patch area shall be removed and replaced with concrete as directed. Base course in the patch area damaged by the contractor shall be removed and replaced with concrete as directed at no direct pay. When base course is patched with concrete an approved bond breaker shall be placed between the base course and the pavement at no direct pay.

Approved wood or metal forms or fiberboard shall be placed for side forms adjacent to shoulders. A maximum 12 inches (300 mm) width of shoulder surfacing and base may be removed to facilitate forming; however, the contractor shall repair any damage to shoulder underdrain systems, and patch removed shoulder areas to the satisfaction of the engineer after form removal at no direct pay.

Concrete for pavement patching shall be Type E complying with Section 901. An approved set-accelerating admixture complying with Subsection 1011.02 may be used in the concrete mix at the dosage recommended by the admixture manufacturer for accelerated curing time. The set accelerator shall be added at the jobsite. The concrete shall be placed, consolidated, finished and cured as directed.

The patched surface shall conform to the existing surface and be textured to match the texture of adjoining pavement. If pavement is to be overlayed, the patched surface shall be drag finished only. The finished patched surface shall meet the surface finish requirements of Subsection 601.11 except that an approved minimum 10-foot (3.0 m) metal static straightedge shall be used.

After the concrete has been placed, transverse joints shall be sawed and sealed as shown on the plans with a sealant complying with Subsection 1005.02(a) in accordance with the manufacturer's recommendations. The longitudinal joint shall be reestablished to match the existing longitudinal joint. Backer material shall be of the size shown on the plans complying with Subsection 1005.02(a).

Patches shall remain closed to traffic a minimum of 72 hours or until standard test specimens conforming to Subsection 601.07 have attained a

compressive strength of 3000 psi (20.7 MPa) when tested in accordance with DOTD TR 230.

If patches are opened to traffic and reclosed for joint sawing and sealing, the patches shall remain closed to traffic until, in the engineer's opinion, the sealants have satisfactorily cured.

602.08 FULL DEPTH PATCHING OF JOINTED CONCRETE PAVEMENT. This work consists of full-depth removal and replacement of portland cement concrete pavement, with proper joints, at locations shown on the plans or as directed, in accordance with plan details and the following requirements.

The contractor shall coordinate activities to limit lane closures. If pavement has been removed and cannot be replaced during daylight hours the contractor shall temporarily backfill the areas with satisfactory aggregate and the lane shall remain closed to traffic.

Saw cuts shall be made with a concrete saw for the full depth of the pavement along the perimeter of the pavement to be removed as marked by the engineer. Spalls in the existing pavement resulting from pavement removal in the patch area shall be repaired by extending the removal limits to include spalled areas. Pavement removal for spall repair shall be made at the full patch width. Repair of the spalled areas shall be at the contractor's expense. Pavement in the patch area shall be removed by one of the following methods.

(1) The pavement may be reduced to appreciable sized pieces by making additional saw cuts or by using hand held jack hammers. The resulting pieces shall be removed by lifting lugs or other approved methods which will not damage the existing base course or the remaining edges.

(2) An approved resonant pavement breaking device may be used to reduce the pavement to pieces which can be removed without damaging the existing base course.

Any other method of removal shall be approved by the engineer. This approval will be subject to the contractor demonstrating satisfactory performance without damage to the base course.

Deteriorated base course in the patch area shall be removed and replaced with concrete as directed by the engineer. Base course in the patch area damaged by the contractor shall be removed and replaced with concrete as directed at no cost to the Department. When base course is patched with concrete an approved bond breaker shall be placed between the base course and the pavement at no direct pay.

Holes for dowel bars and tie bars shall be drilled into vertical faces of the

adjoining pavement, and bars shall be installed with an approved adhesive anchor system listed on QPL 32 or 52 as directed and shown on the plans. The free end of the dowel bar shall be lightly oiled or greased.

Approved wood or metal forms shall be placed for side forms adjacent to shoulders. A maximum 12 inches (300 mm) width of shoulder surfacing and base may be removed to facilitate forming; however, the contractor shall repair any damage to shoulder underdrain systems, and patch removed shoulder areas to the satisfaction of the engineer after form removal at no direct pay.

Concrete for pavement patching shall be Type E complying with Section 901. An approved set-accelerating admixture complying with Subsection 1011.02 may be used in the concrete mix at the dosage recommended by the admixture manufacturer for accelerated curing time. The set accelerator shall be added at the jobsite. The concrete shall be placed, consolidated, finished and cured as directed.

The patched surface shall conform to the existing surface and be textured to match the texture of adjoining pavement. If pavement is to be overlayed, the patch surface shall be drag finished only. The finished patched surface shall meet the surface finish requirements of Subsection 601.11 except an approved minimum 10-foot (3.0 m) metal static straightedge shall be used.

Patches shall remain closed to traffic a minimum of 72 hours or until standard test specimens conforming to Subsection 601.07 have attained a compressive strength of 3000 psi (20.7 MPa) when tested in accordance with DOTD TR 230.

Transverse joints shall be formed or sawed, then sealed with a sealant complying with Subsection 1005.02(a) in accordance with plan details and manufacturer's recommendations. Backer material shall be of the size shown on the plans complying with Subsection 1005.02(a).

In areas where a bond breaker is required in longitudinal joints, the bond breaker shall be a 6-mil (150 μm) (nominal) polyethylene sheet or approved equal. The bond breaker shall be placed the full thickness of the slab.

If patches are opened to traffic and reclosed for joint sawing and sealing, the patches shall remain closed to traffic until, in the engineer's opinion, the sealants have satisfactorily cured to tack free.

602.09 PARTIAL DEPTH PATCHING OF JOINTED CONCRETE PAVEMENT. This work consists of partial depth patching of concrete pavement in accordance with plan details and the following requirements.

(a) Patch Preparation: Saw cuts shall be made with a concrete saw along the perimeter of the pavement to be removed as marked by the engineer.

The saw cut shall be made to the depth of unsound concrete, as determined by the engineer, but shall not be less than 1 1/2 inches (40 mm) nor more than 4 inches (100 mm). If the depth of unsound concrete exceeds 4 inches (100 mm), a full-depth patch shall be placed and payment made under that pay item. Unsound concrete within the patch area shall be removed with approved pneumatic tools having a maximum weight (mass) of 30 pounds (14 kg).

Before placing repair material, transverse and longitudinal joints within or adjacent to patch areas shall be sawed to within 1/2 inch (13 mm) of load transfer or tie steel, and fiberboard or other approved material shall be placed in the joint. The fiberboard, or other approved material, shall be placed to the bottom of the saw cut.

Concrete surfaces within the patch area shall be cleaned of loose particles, oil, dust, traces of asphaltic concrete, joint material and other contaminants by sandblasting before patching. All sandblasting residue shall be removed prior to placement of the patching material.

(b) Patching Material: The contractor has the option of using either portland cement concrete or epoxy mortar for partial depth patching of concrete pavement.

(1) Portland Cement Concrete: Portland cement concrete for pavement patching shall be Type E complying with Section 901, except that a Grade F aggregate shall be used. An approved non-chloride type set-accelerating admixture complying with Subsection 1011.02 may be used in the concrete mix at the dosage recommended by the admixture manufacturer for maximum strength. The set accelerator shall be added at the job site.

Steel fibers complying with ASTM A-820, Type I or II shall be added to the mix. The nominal length of the fibers shall not be less than 1 inch (25 mm) nor greater than 1 1/2 inches (40 mm). The fiber shall be deformed and shall have an aspect ratio not less than 40 or greater than 60. The concrete shall contain 85 to 90 pounds per cubic yard (51 to 54 kg/cu m) of steel fibers**.** The fibers shall remain packaged until such time as they are included in the mix. Fibers with a nominal length greater than 1 inch (25 mm) shall be bonded together with water soluble glue. Fibers with a nominal length of 1 inch (25 mm) are not required to be bonded together. Glued fibers shall be the last material added to the mix and they shall be added at a rate not exceeding 132 lbs (60 kg) of fibers per minute. Additional mixing at the manufacturer's recommended mixing speed for at least l minute is required after addition of the fibers. Mixer capacity prior to the addition of the fibers shall not exceed 80 percent. Non-bonded fibers shall be blended with the aggregate in such a manner to prevent clumping of the fibers prior to addition of cement and water. Tightly bound or clumped steel fibers shall be broken up or prevented

from entering the mix. The fibers may be screened prior to placing onto the aggregate conveyor belt.

(2) Epoxy Mortar: The patching material shall be an epoxy mortar consisting of a mixture of epoxy resin system and thoroughly dry fine aggregate. The epoxy resin system shall be Type I Grade B complying with Section 1017. The epoxy resin system shall be light gray in color. The epoxy components shall be mixed in strict compliance with the manufacturer's mixing recommendations before the fine aggregate is added to the mixture. Epoxy mortar that has begun to generate appreciable heat shall be discarded. The fine aggregate shall consist of a packaged blasting sand. The sand, prior to mixing, shall be in an oven dry condition. The mixture proportions of the epoxy mortar shall be one part epoxy resin system to approximately three parts blasting sand, 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. The dry aggregate shall be stored and proportioned so as to yield a uniformly combined material. The epoxy resin system and blasting sand shall be mixed in equipment and by methods that produce a homogenous mixture.

(c) Construction Requirements:

(1) Portland Cement Concrete: Concrete surfaces within the patch area shall be cleaned of loose particles, dust and debris, and a bonding grout shall be applied to the existing concrete in the patch area with a stiff bristle brush just before placement of the new concrete. Grout shall consist of equal parts of portland cement and sand by weight (mass) with enough water to provide a stiff slurry. Grout shall be continuously agitated, and shall be used within 90 minutes.

The concrete shall be placed, consolidated, finished and wet cured as directed.

The patch surface shall conform to the existing surface and be textured to match the texture of adjoining pavement. The finished patch surface shall meet the surface finish requirements of Subsection 601.11 except an approved 10-foot (3.0 m) metal static straightedge shall be used.

After the concrete has been placed, consolidated, and cured, transverse joints shall be sawed and sealed as shown on the plans with a sealant complying with Subsection 1005.02(a) in accordance with the manufacturer's recommendations. The longitudinal joint shall be reestablished to match the existing longitudinal joint. Backer material shall be of the size shown on the plans and shall comply with Subsection 1005.02(a). If patches are opened to traffic and re-closed for joint sawing and sealing, the patches shall remain closed to traffic until, in the engineer's opinion, the sealants have satisfactorily

cured to tack free.

Patches shall remain closed to traffic until standard test specimens conforming to Subsection 601.07 have attained a compressive strength of 3200 psi (22.0 MPa) when tested in accordance with DOTD TR 230.

(2) Epoxy Mortar: The surface of the repair areas shall be heavily primed with neat blended epoxy immediately before the epoxy mortar is placed. Priming shall include overlapping the surface of the area adjacent to the patch. The mixture shall be placed and tamped with sufficient effort to eliminate voids and to thoroughly compact the product. All patches shall be finished to the cross section of the existing pavement.

After the epoxy mortar has been placed, any transverse joints shall be sawed and sealed as shown on the plans with a sealant complying with Subsection 1005.02(a) in accordance with manufacturer's recommendations. Any longitudinal joint shall be reestablished to match the existing longitudinal joint. Backer material shall comply with Subsection 1005.02(a).

The patch surface shall conform to the existing surface and be textured to match the texture of adjoining pavement. The finished patch surface shall meet the surface finish requirements of Subsection 601.11 except an approved 10-foot (3.0 m) metal static straightedge shall be used.

Patches shall remain closed to traffic for at least 2 hours at air temperatures of over 60°F (16°C), and at least 4 hours at lower air temperatures unless otherwise approved by the engineer. If patches are opened to traffic and re-closed for joint sawing and sealing, the patches shall remain closed to traffic until, in the engineer's opinion, the sealants have satisfactorily cured to tack free.

602.10 PATCHING CONTINUOUSLY REINFORCED CONCRETE PAVEMENT.

This work consists of removing and replacing continuously reinforced portland cement concrete pavement at locations shown on the plans or as directed, in accordance with plan details and the following requirements.

Patching operations shall be conducted in one lane at a time. Patching operations shall not be performed in the adjacent lane until the previously patched lane has been reopened to traffic. Patches shall remain closed to traffic a minimum of 72 hours or until standard test specimens conforming to Subsection 601.07 have attained a compressive strength of 3,000 psi (20.7 MPa) when tested in accordance with DOTD TR 230.

When possible, pavement removal and replacement shall be completed during daylight hours. If pavement has been removed and cannot be replaced during daylight hours the patch area shall be temporarily backfilled with satisfactory aggregate and shall remain closed to traffic until the patch is

completed.

Prior to pavement removal, the patch area shall be outlined by saw cutting the pavement to a minimum depth of 1 1/2 inches (40 mm) and the pavement shall be cut full depth 18 inches (450 mm) from the edges of the patch as shown on the plans. Only one lane shall be full depth saw cut at a time. Pavement shall then be removed in such a manner that reinforcing bars projecting in the patch area are not bent or damaged. Hammers used for pavement removal in the 18-inch (450 mm) splice area shall not exceed 40 lbs (20 kg).

Deteriorated base course in the patch area shall be removed and replaced with concrete as directed. Base course in the patch area, damaged by the contractor, shall be removed and replaced with concrete as directed by the engineer at no direct pay. When base course is patched with concrete an approved bond breaker shall be placed between the base course and the pavement at no direct pay.

Deformed reinforcing steel shall be of the same size as the removed steel and shall be tied to projecting steel bars to provide at least 16 inches (400 mm) of lap. Grade 40 or 60 (Grade 300 or 420) may be used at the option of the contractor. Transverse steel shall be placed first on approved chairs, and longitudinal bars shall be placed on transverse bars and tied at bar intersections.

The contractor shall protect the existing shoulder surfacing, base course and underdrain system from damage during pavement removal operations, and shall place an approved 6-mil (150 μm) (nominal) polyethylene sheeting over exposed underdrain system areas before placement of concrete for the patch. Damaged shoulder surfacing, base course and underdrain system shall be satisfactorily repaired at no cost to the Department.

Concrete for pavement patching shall be Type E complying with Section 901. An approved non-chloride type set-accelerating admixture complying with Subsection 1011.02 may be used in the concrete mix at the dosage recommended by the admixture manufacturer for maximum strength. The set accelerator shall be added at the jobsite. Vertical surfaces of existing pavement in the patch areas shall be coated with a neat cement grout immediately prior to placement of new concrete. The concrete shall be placed, consolidated, finished and cured as directed.

The patch surface shall conform to the existing surface and be textured to match the texture of adjoining pavement. The finished patch surface shall meet the surface finish requirements of Subsection 601.11, except an approved 10-foot (3.0 m) metal static straightedge shall be used.

602.11 GRINDING. This work consists of grinding existing pavement roadway surfaces in accordance with plan details and the following requirements.

(a) General Requirements: Areas of the pavement surface as designated on the plans shall be ground to eliminate joint and crack faults and to provide a constant pavement cross slope within the designated grinding limits in each lane. Adjacent sides of transverse joints or cracks in excess of 1/8-inch (3 mm) difference in plane when checked with a 3-ft (1 m) straightedge, shall be reground until flush. Extra depth grinding will not be required to texture small low areas but the depth shall be sufficient to provide 98 percent texture coverage.

(b) Equipment: Grinding shall be accomplished by sawing with an industrial diamond abrasive which is impregnated in the saw blades. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the concrete pavement or joint faces. The saw blades shall be 1/8-inch (3 mm) wide and there shall be a minimum of 55 to 60 blades per 12 inches (300 mm) of cutting head width depending on the hardness of the aggregate. Grinding equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. Grinding equipment shall be capable of working in a closed lane, adjacent to an open traffic lane.

Each grinding machine shall weigh a minimum of 16 tons (14.5 Mg) and be powered with at least 300 horsepower (225 kw). Each machine shall be capable of cutting a path 3 to 4 ft (0.9 to 1.2 m) wide and within 12 inches (300 mm) of the face of the concrete curb. Sufficient equipment shall be furnished to complete the project in the working time specified.

Vacuuming equipment shall be provided for the removal of the slurry residue and excess water.

(c) Operations: The grinding operations shall produce a consistent cross slope without abrupt edges between passes of the grinding machine. When tested with a 12-foot (3.7 m) straightedge perpendicular to centerline, the variation shall not exceed 1/4 inch (6 mm). The slurry produced shall not be permitted to flow across active traffic lanes and shall be collected and disposed of before being blown by traffic or wind. When practical, slurry may be disposed of on the slope near the shoulder edge as the machine progresses down the roadway, unless otherwise directed.

Grinding shall follow removal of raised pavement markers, patching, and load transfer restoration, but should precede joint sealing, striping and replacement of raised pavement markers.

Grinding shall be performed in a longitudinal direction and shall begin and end at lines normal to the pavement centerline. The area ground shall not be left slick or polished but shall have a "corduroy-like", longitudinal line type texture. The entire travel way shall be ground as indicated on the plans or as directed by the project engineer.

Before grinding operations begin, the lane to be ground shall be profiled by the contractor with an approved profilograph and any designated test sections containing low areas of concern shall be brought to the attention of the project engineer by the contractor. These low sections will not be required to meet the specified Profile Index but the finished profile shall provide a 70 percent improvement over the "before-grinding" profile. The contractor shall utilize this "before-grinding" profile trace to select areas that may require multiple grinding passes.

(d) Final Surface: After the grinding is completed the pavement shall be tested with a profilograph for smoothness. Tangent sections and pavements with horizontal curves having a radius greater than 2000 ft (600 m) shall have a maximum Profile Index of 7 inches per mile (110 mm/km). Pavement with horizontal curves having a radius from 1000 to 2000 ft (300 to 600 m) shall have a maximum Profile Index of 9 inches per mile (145 mm/km).

The pavement texture, which is a function of blade width, blade spacing and cutting head alignment, shall be inspected after each new or rebuilt cutting head has ground 1000 ft (300 m). Grooves shall be approximately 1/8-inch (3 mm) wide. The fins between the grooves shall be approximately 1/10-inch (2.5 mm) thick and the typical height of the fins above the bottom of the grooves shall be approximately 1/16 inch (1.2 mm). Blade spacing shall be adjusted as necessary when the results fail to come within 25 percent of this criteria. If standing fins are not easily knocked off by foot, more blades with a closer spacing may be required. If, in the engineer's opinion, the fin height is not adequate to provide good skid resistance, blades shall be removed and a wider spacer used.

602.12 LONGITUDINAL SHOULDER JOINT. This work consists of constructing a longitudinal joint in designated asphaltic concrete shoulder surfacing adjacent to the portland cement concrete pavement in accordance with plan details and the following requirements as directed.

Joints shall be formed by sawing a slot approximately 1/2-inch (13 mm) wide and 1/2-inch (13 mm) deep in the asphaltic concrete shoulder adjacent to the portland cement concrete pavement. The slot shall be flushed with water immediately after sawing.

Just prior to placing joint sealant, the joint shall be blown free of sand and water with compressed air. The compressor shall be equipped with an approved oil and water trap. The joint shall be dry before sealing. Prepared joints shall be sealed within 24 hours. Joints which have become contaminated or dirty before sealing shall be recleaned as directed by the engineer. In areas where the shoulder has separated more than 1/2-inch (13 mm) from the pavement edge, backer material shall be placed in the joint prior to sealing.

Sealing materials shall be hot poured sealant complying with Subsection 1005.02(a) installed in accordance with the sealant manufacturer's recommendations. The sealed joint shall remain closed to traffic until, in the engineer's opinion, the sealant has satisfactorily cured to tack free.

602.13 REMOVAL OF EXISTING SHOULDER UNDERDRAIN SYSTEMS. This work consists of removing the existing shoulder underdrain system including outfall and backfilling the trench as required by the plan details and the following requirements.

The contractor shall remove the existing cap along the pavement edge and at the outfall locations, geotextile fabric, pipe, fittings, aggregate and other incidentals associated with the shoulder underdrain system to the satisfaction of the engineer. Particular attention shall be placed on removal of the geotextile fabric adjacent to the pavement edges to ensure all fabric is removed.

The contractor shall remove the concrete headwall and rodent screen. The outfall pipe shall be abandoned by plugging and backfilling to the satisfaction of the engineer.

The trench left after removal of the shoulder underdrain system shall be backfilled as required to accommodate installation of the new shoulder underdrain system. No more trench shall be opened than can be backfilled in the same day.

602.14 UNDERSEALING OR SLABJACKING PAVEMENT. This work consists of drilling holes in concrete pavement and pumping fly ash/cement slurry under the pavement to fill cavities (undersealing) or to raise the elevation of the pavement slabs (slabjacking).

(a) Materials:

(1) Portland Cement: Cement shall be Type I complying with Section 1001.

(2) Water: Water shall comply with Subsection 1018.01.

(3) Fly Ash: Fly ash shall comply with Subsection 1018.15.

(4) Powdered Ammonium Lignin Sulphonate: Powdered ammonium lignin sulphonate may be used as a fluidifier and water-reducing agent.

(b) Equipment. Equipment shall include the following.

(1) Air Compressors and Drills: Air compressors shall be equipped with air-lift pneumatic drills capable of drilling the required holes.

(2) Mixer: Mixer shall be a high speed (800 to 2000 rpm) colloidal mixer, or as approved, capable of thoroughly mixing slurry ingredients.

(3) Roller: The roller shall be a pneumatic-tire vehicle capable of exerting a single-axle load of 9 tons (8 Mg).

(c) Proportioning and Consistency:

(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 Heading (2). When directed or approved, powdered ammonium lignin sulphonate shall be added at the rate of 0.5 to 1.5 percent by weight (mass) of cement.

(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.

(d) Construction Requirements:

(1) General: Holes of approximately 1 1/2 inches (40 mm) in diameter shall be drilled through pavement at locations specified on the plans or as directed. Drills shall be rotated to avoid cracking pavement and shall be held as nearly perpendicular as possible to pavement surfaces. Holes shall be cleaned with compressed air under pressure prior to undersealing. Holes which cannot be satisfactorily used shall be filled with slurry and new holes drilled. No more holes shall be drilled than can be used during a day's operations.

After holes are drilled, a pipe connected to the discharge hose of the pressure pump shall be lowered into the hole. Discharge end of the pipe shall not extend below the bottom of pavement.

When stooling of slurry occurs, additional holes shall be provided in the slab as directed. A more fluid slurry shall be pumped through these new holes to fill voids between stools.

When back pressure forces slurry out of the hole onto the slab after withdrawal of discharge pipe, the hole shall be temporarily plugged until the slurry has set. After completion of pumping in a hole, the discharge pipe or plug shall be removed and the hole filled with slurry.

Drainage structures shall be kept clean of slurry mixture. The contractor

shall monitor all drainage structures within the areas being pumped. When the pumping operation is forcing the slurry into a drainage structure, the contractor shall discontinue pumping operations and immediately clean the drainage structure of slurry mixture.

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

Pavement and shoulder surfaces shall be kept free of slurry mixture during undersealing operations.

Pumping operations shall be discontinued at least 1 hour before opening the pavement to traffic.

(2) Undersealing: Pumping of slurry into a hole shall continue until all voids beneath the pavement are filled. Lifting of the slab or slurry flowing out of an adjacent hole, through pavement joints or cracks, or out of the shoulder-pavement joint shall be sufficient evidence that all cavities are filled within range of the hole being pumped. Pumping pressures over 200 psi (1400 kPa) will not be permitted. When pressures cause pavement lifting, a lower pumping pressure shall be used. Lifting of the slab as a result of pumping shall not exceed 1/8 inch (3 mm). The contractor shall monitor the slab lifting by approved methods at all times during undersealing. Any pumping operation that causes voids to form under the pavement in the immediate area shall be terminated. The sequence of pumping from hole to hole shall be as directed.

(3) Slabjacking: Pumping operations for slabjacking shall be conducted in an approved manner and sequence. The contractor shall monitor the slab lifting at all times during pumping operations. Pumping shall continue until pavement slabs have been raised to the required grade within a tolerance of ±1/8 inch (±3 mm).

602.15 DOWEL BAR RETROFIT. This work consists of installing plastic coated 1 1/2 inch (38 mm) diameter by 18 inch (450 mm) long plain round dowel bars into slots cut across and through existing concrete pavement transverse joints. The existing portland cement concrete pavement shall be removed from the slots and the dowel bars shall be retrofitted across the pavement joints. The voids surrounding the dowel bars shall be filled with a concrete patching material. The transverse joints shall be sawed and sealed as required in the plans. All work shall conform to the plan details, and the following requirements.

The use of patented processes or devices for simultaneous cutting of slots for dowel bar retrofitting shall conform to Subsection 107.03.

(a) Materials: Dowel bars shall be in accordance with Subsection 1009.04.

The dowel bars shall have tight fitting nonmetallic end caps that allow for 1/4-inch (6 mm) bar movement at each end of the bar. The contractor shall submit an end cap sample to the project engineer for approval prior to installation.

Nonmetallic chair devices shall be used 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. The contractor shall submit a chair sample to the project engineer for approval prior to installation.

The foam core board filler material shall be 1/4-inch (6 mm) thick, constructed of closed cell foam and faced with poster board material on each side.

The caulk for sealing the existing transverse joint at the bottom and sides of the slot shall be a commercial grade of silicone caulk containing a minimum of 50 percent silicone.

A low shrinkage cementitious concrete patching material used to backfill the slots shall be selected from QPL 24 under Rapid Setting Patching Materials for Concrete and shall meet the following requirements when tested at the water content used at the project site.

(1) Compressive strength 3 hr., minimum 3,000 psi (20.7 MPa) - ASTM C 109

(2) Compressive strength 24 hr., minimum 5,000 psi (34.5 MPa) - ASTM C 109

(3) Shrinkage 4 days, 0.13 percent maximum - ASTM C 157

The contractor shall 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.

(b) Construction Requirements: The dowel bars shall be installed as follows:

Saw cut slots in the pavement shall be parallel to the centerline of the roadway and 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. The saw cuts for the slots at each transverse joint shall be made such that the dowel bars can be

positioned parallel to the roadway centerline and surface in accordance with plan details.

Jack hammers used to break loose concrete shall not be larger than the 30-pound (15 kg) class. If the 30-pound (15 kg) jack hammer damages the pavement, the project engineer will require the contractor to use a lighter weight hammer.

All exposed surfaces and cracks in the slot shall be sand blasted and cleaned prior to bar installation. Air compressors shall be equipped with approved oil and moisture traps.

The transverse contraction joint on the bottom and the sides of the slot shall be filled with silicone caulk. Caulking material at the bottom and sides of the slot that will result in breaking of the bond with the patching material shall be cleaned prior to patching.

The dowel bars shall be lightly oiled or greased prior to placement. The bar chairs shall provide a minimum of 1/2-inch (13 mm) clearance between the bottom of the dowel bar and the bottom of the slot. The dowel bars shall be centered over the transverse joint, placed in the middle of the slot to the depth shown on the plans, and shall be 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.

A 1/4-inch (6 mm) thick foam core board shall be placed at the middle of the dowel bar to maintain the transverse contraction joint. The existing joint sealant may need to be cut or removed 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. The top of the foam core board shall be 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.

The contractor shall 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. Care shall be taken to prevent standing water in the slot. All excess water shall be removed with compressed air.

The contractor shall fill the slot (with the installed dowel bar, chairs, foam core board, and silicone in place) with an approved patching material. The patching material shall be mixed in accordance with the manufacturer's recommendations and with mixing equipment approved by the engineer. The patching material shall be vibrated with a small hand held vibrator capable of thoroughly consolidating the patching compound into the slot and around the dowel bar. The top surface of the filled slot shall be trowel finished and

cured. The patched areas shall be cured as directed by the patching material manufacturer.

The contractor shall provide six 2-inch (50 mm) 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. Test specimens shall be made in accordance with ASTM C 192. If the compressive strengths are not being met, production shall cease and the contractor shall take corrective measures to the satisfaction of the engineer.

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

The transverse joints shall be sawed, then sealed with a sealant complying with Subsection 1005.02(c) in accordance with plan details and the manufacturer's recommendations. Backer material shall be of the size shown on the plan details and shall be selected from QPL 42.

All dowel bars not functioning or damaged shall be repaired or replaced at no cost to the Department.

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

(a) Cleaning and Filling Existing Longitudinal Pavement Joints will be measured by the linear foot (lin m).

(b) Cleaning and Resealing Existing Longitudinal and Transverse Pavement Joints will be measured by the linear foot (lin m).

(c) Cleaning and Sealing Cracks will be measured by the linear foot (lin m) along the centerline of the crack at the pavement surface.

(d) Full Depth Corner Patching of Jointed Concrete Pavement will be measured by the square yard (sq m).

(e) Full Depth Patching of Jointed Concrete Pavement will be measured by the square yard (sq m).

(f) Partial Depth Patching of Jointed Concrete Pavement will be measured by the square yard (sq m).

(g) Patching of Continuously Reinforced Concrete Pavement will be measured by the square yard (sq m).

(h) Grinding will be measured by the square yard (sq m). Additional passes of the grinder will be considered to be incidental. The quantity of pavement grinding to be paid for will be determined by multiplying the width of the ground area by the horizontal length ground. Only the final ground area will be measured for payment on pavement areas that require multiple grinding passes.

(i) Longitudinal Shoulder Joints will be measured by the linear foot (lin m).

(j) Removal of Existing Shoulder Underdrain Systems will be measured by the linear foot (lin m) along the pavement edge.

(k) Undersealing Pavement or Slabjacking Pavement will be measured by the ton (Mg) of portland cement used in the slurry. Holes for undersealing or slabjacking will be measured per each. Fly ash, admixtures, and water will not be measured for payment.

(l) Dowel Bar Retrofit will be measured per each dowel bar installed and accepted.

602.17 PAYMENT. Payment for portland cement concrete pavement rehabilitation will be as follows:

(a) Cleaning and Filling Existing Longitudinal Pavement Joints: Payment for cleaning and filling longitudinal pavement joints will be made at the contract unit price per linear foot (lin m) which includes furnishing all materials and performing the work as specified under Subsection 602.04.

(b) Cleaning and Resealing Existing Longitudinal and Transverse Pavement Joints: Payment for cleaning and resealing existing longitudinal and transverse pavement joints will be made at the contract unit price per linear foot (lin m) which includes furnishing all materials and performing the work as specified under Subsection 602.05.

(c) Cleaning and Sealing Cracks: Payment for cleaning and sealing cracks will be made at the contract unit price per linear foot (lin m) which includes furnishing all materials and performing the work as specified under Subsection 602.06.

(d) Full Depth Corner Patching of Jointed Concrete Pavement: Acceptance and payment for full depth corner patching of jointed concrete pavement will be made on a lot basis at the contract unit price per square yard (sq m), adjusted in accordance with the following provisions. A lot will be a completed section or an identifiable pour completed in one day. Two random batches will be sampled for each lot with three cylinders molded for each batch. The six specimens per lot will be tested for compressive strength in 28 to 31 days. In the event of sudden cessation of operations, a minimum of three cylinders will represent a lot. Acceptance and payment for each lot will be based on the compressive strengths of Table 601-1.

Payment for full depth corner patching of jointed concrete pavement per square yard (sq m) includes furnishing all materials and performing the work as specified in Subsection 602.07.

Payment for deteriorated base course removed as directed and replaced with concrete will be made in accordance with Section 601.

(e) Full Depth Patching of Jointed Concrete Pavement: Acceptance and payment for full depth patching of jointed concrete pavement will be made on a lot basis at the contract unit price per square yard (sq m), adjusted in accordance with the following provisions. A lot will be an identifiable pour as described in Heading (d) of this subsection. Acceptance and payment for each lot will be based on the compressive strengths of Table 601-1.

Payment for full depth patching of jointed concrete pavement per square yard (sq m) includes furnishing all materials and performing the work as specified in Subsection 602.08.

Payment for deteriorated base course removed as directed and replaced with concrete will be made in accordance with Section 601.

(f) Partial Depth Patching of Jointed Concrete Pavement: Payment for partial depth patching of jointed concrete pavement will be made by the contract unit price per square yard (sq m) which includes furnishing all materials and performing the work as specified in Subsection 602.09.

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 (sq m). Acceptance and payment for each lot will be based on the compressive strengths of Table 601-1.

(g) Patching Continuously Reinforced Concrete Pavement: Payment for continuously reinforced concrete pavement will be made on a lot basis at the contract unit price per square yard (sq m), adjusted in accordance with the following provisions. A lot will be an identifiable pour as described in Heading (d) of this subsection. Acceptance and payment for each lot will be based on the compressive strengths of Table 601-1.

Payment for patching continuous reinforced concrete pavement per square yard (sq m) includes furnishing all materials and performing the work as specified in Subsection 602.10.

Payment for deteriorated base course removed as directed and replaced with concrete will be made in accordance with Section 601.

(h) Grinding Concrete Pavement and Joints: Payment for grinding concrete pavement and joints will be paid for at the contract unit price per square yard (sq m) which will include furnishing all labor, materials, tools, equipment, and incidentals involved in grinding the pavement, and disposing of the slurry residue.

(i) Longitudinal Shoulder Joint: Payment for longitudinal shoulder joint will be made at the contract unit price per linear foot (lin m) which

includes furnishing all materials and performing the work as specified in Subsection 602.12.

(j) Removal of Existing Shoulder Underdrain Systems: Payment for removal of existing shoulder underdrain systems will be made at the contract unit price per linear foot (lin m) which includes plugging and backfilling of outfalls, furnishing all materials and performing the work as specified in Subsection 602.13.

(k) Undersealing and Slabjacking Pavement: Payment for undersealing pavement and slabjacking pavement will be made at the contract unit price per ton (Mg) of portland cement. Holes for undersealing pavement and slabjacking pavement will be made at the contract unit price per each. Payment under these contract items include furnishing all materials and performing the work as specified in Subsection 602.14.

(l) Dowel Bar Retrofit: Payment for dowel bar retrofits will be made at the contract unit price per each, which includes furnishing all materials and performing the work as specified in Subsection 602.15.

Payment will be made under:

Item No.	Pay Item	Pay Unit
602-01	Cleaning and Filling Existing Longitudinal Pavement Joints	Linear Foot (Lin m)
602-02	Cleaning and Resealing Existing Longitudinal and Transverse Pavement Joints	Linear Foot (Lin m)
602-03	Cleaning and Sealing Cracks	Linear Foot (Lin m)
602-04	Full Depth Corner Patching of Jointed Concrete Pavement	Square Yard (Sq m)
602-05	Full Depth Patching of Jointed Concrete Pavement	Square Yard (Sq m)
602-06	Partial Depth Patching of Jointed Concrete Pavement	Square Yard (Sq m)
602-07	Patching Continuously Reinforced Concrete Pavement	Square Yard (Sq m)
602-08	Grinding Concrete Pavement	Square Yard (Sq m)
602-09	Grinding Isolated Joints	Square Yard (Sq m)
602-10	Longitudinal Shoulder Joints	Linear Foot (Lin m)
602-11	Removal of Existing Shoulder Underdrain Systems	Linear Foot (Lin m)
602-12	Undersealing Pavement	Ton (Mg)
602-13	Slabjacking Pavement	Ton (Mg)
602-14	Holes	Each
602-15	Dowel Bar Retrofit	Each