

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 random 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 which have become contaminated or dirty before

602.04

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 RANDOM CRACKS. This work consists of cleaning and sealing random 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. Random 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. Random 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.

602.07

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, except that the water cement ratio shall be a maximum of 0.40 and the mixture shall contain at least 658 pounds (387 kg) of Type I portland cement per cubic yard (cu m) of concrete. An approved 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. 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 overlaid, 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 (21.0 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 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.

602.08

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, except that the water cement ratio shall be a maximum of 0.40 and the mixture shall contain at least 658 pounds (387 kg) of Type I portland cement per cubic yard (cu m) of concrete. An approved 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. 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 overlaid, 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 (21.0 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 μ m) (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 the water cement ratio shall be a maximum of 0.40 and the mixture shall contain at least 658 pounds (387 kg) of Type I portland cement per cubic yard (cu m) of concrete and 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

602.09

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 1 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. 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

602.10

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 (21.0 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 sawcutting 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 μ m) (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, except that the water cement ratio shall be a maximum of 0.40 and the mixture shall contain at least 658 pounds (387 kg) of Type I portland cement per cubic yard (cu m) of concrete. 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. 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,

602.11

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 travelway 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) or more shall have a maximum Profile Index of 7 inches per mile (110 mm/km). Pavement with horizontal curves having a radius between 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

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 or I(B) 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 $\pm 1/8$ inch (± 3 mm).

602.15

602.15 CROSS-STITCHING RANDOM LONGITUDINAL CRACKS.

This work consists of cross-stitching longitudinal cracks in concrete pavement by epoxying deformed tie bars across the pavement crack in accordance with plan details and following requirements.

Angled holes shall be drilled on each side of the longitudinal crack at spacing shown on the plans. The contractor will be required to drill shallow, vertical starter holes at each tie bar location if the angle drill spalls the pavement surface at the start of drilling operations. The holes shall be blown out with compressed air and shall be dry prior to filling with epoxy. The air compressor shall be equipped with an approved oil and water trap. Holes shall be filled with a Type 1, Grade C epoxy system listed under QPL 32. The color of the epoxy system shall approximate that of the concrete pavement. The epoxy shall be mixed in accordance with the manufacturer's recommendations and injected into the hole using a caulking gun or other approved method. 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. The top of the reinforcing bar shall be below the pavement surface, and excess epoxy shall be removed flush with the surface of the pavement. Epoxy shall not be applied when the ambient temperature is below 40°F (4°C).

After the tie bars have been placed and the epoxy has cured, the random crack shall be routed to a minimum depth of 3/4 inch (20 mm) and to a width of not less than 3/8 inch (10 mm) or more than 5/8 inch (16 mm). The crack shall be sealed with a silicone sealant conforming to Subsection 1005.02(c) and the sealant shall be recessed 1/4 inch (6 mm) below the pavement surface. The engineer may elect not to route and seal if the random crack is tight.

602.16 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 form 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.

(1) Compressive strength 3 hr., minimum 3000 psi (21.0 MPa) - ASTM C 109

(2) Compressive strength 24 hr., minimum 5000 psi (35.0 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

602.16

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.

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.

602.17 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 Random 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.

602.17

(l) Cross-Stitching Random Longitudinal Cracks will be measured by the linear foot (lin m) along the centerline of the crack at the pavement surface.

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

602.18 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 Random Cracks: Payment for cleaning and sealing random 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 Subsection 724.08(a).

(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 Subsection 724.08(a)

(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 Subsection 724.08(a).

(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 furnishing all materials and performing the work as specified in Subsection 602.13.

602.18

(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) Cross-Stitching Random Longitudinal Cracks: Payment for cross-stitching random longitudinal 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 in Subsection 602.15.

(m) 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 602.16.

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 Random 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	Cross-Stitching Longitudinal Joints	Linear Foot (Lin m)
602-16	Cross-Stitching Random Longitudinal Joints	Linear Foot (Lin m)
602-17	Dowel Bar Retrofit	Each