SECTION 613

PAVEMENT REPAIR

613.1 Description. This work shall consist of performing partial depth pavement repair, full depth pavement repair, or retrofitting dowel bars at locations as shown on the plans or as directed by the engineer.

613.2 Material. All material, unless specified otherwise in this specification, shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Steel Wire Fabric for Concrete Pavement	1036
Epoxy or Polyester Bonding Agents for Dowels	1039
Concrete Curing Material	1055
Material for Joints	1057

613.3 Construction Requirements.

613.3.1 All pavement repair subsequent to sawing or removal of any pavement shall be accomplished in the same day, except as follows. If approved by the engineer, sawing may be accomplished the day before removal, but shall be repaired the following working day. Any damage caused to the pavement due to pre-sawing shall be repaired by the contractor at the contractor's expense.

613.3.2 Repairs shall be made to only one lane at a time, unless the traffic control plan specifies otherwise. The removed concrete or bituminous material and any excavated subgrade material shall be disposed of at a location furnished by the contractor, or at locations on the right of way approved by the engineer. If the material is disposed of outside the right of way, an acceptable written agreement with the property owner on whose property the material is placed shall be submitted to the engineer by the contractor.

613.3.3 If the repaired area is not to be resurfaced, the overcut from the sawing operation shall be filled with an expansive mortar, epoxy, polyester or joint material as approved by the engineer.

613.3.4 Weather limitations shall be in accordance with Sec 502 for placement of concrete material and Sec 403 for placement of bituminous material.

613.3.5 All repaired areas shall be finished to provide a smooth ride, and to the satisfaction of the engineer. Repaired areas shall be checked by stringline if required by the engineer. When stringlined, the surface of the repaired area shall not vary more than 1/8 inch per 10 feet (3 mm/3 m) from a straight line between the surface of the existing pavement on each side of the repaired area, regardless of whether the repair is to be resurfaced or not.

613.3.6 Any damage to the existing pavement, joints and cracks adjacent to the pavement repair, caused by the contractor's operation shall be repaired at the contractor's expense.

SECTION 613.10 FULL DEPTH PAVEMENT REPAIRS

613.10.1 Description. Full depth pavement repairs shall consist of removing specified areas of existing variable thickness Portland cement concrete pavement and subsequent bituminous overlays and replacing the removed material with reinforced or non-reinforced Portland cement concrete as shown on the plans.

613.10.2 Construction Requirements.

613.10.2.1 Specified areas of full depth pavement repair shall be removed in accordance with Sec 202, except the saw cut shall be full depth. An approved saw, such as a diamond saw, shall be used for perimeter cuts. A rock saw may be used to make a cut through the middle portion of the area to be removed for stress relief. The full depth of the pavement shall be removed without mechanically breaking in place, and with a minimum disturbance of sound base. Any aggregate base disturbed by the contractor shall be recompacted or removed. Unstable base aggregate shall be removed and replaced in accordance with Sec 304 as directed by the engineer. Subgrade compaction shall be performed in areas of unstable subgrade in accordance with Sec 210, if directed by the engineer. If subgrade compaction is performed, the aggregate base shall be replaced. Compaction shall be to the satisfaction of the engineer and inspection will be made visually.

613.10.2.2 All full depth Class A pavement repairs exceeding 10 feet (3.0 m) in length and all full depth Class B pavement repairs exceeding 30 feet (9 m) in length shall be constructed with tie bars along the longitudinal centerline joint in accordance with Sec 502. Dowel bars, tie bars and holes shall be as shown on the plans. Dowel bars shall be 1 1/4 x 18 inches (32 x 450 mm) and epoxy coated. Tie bars shall be No. 6 bars, 18 inches (450 mm) long and epoxy coated. Bar holes shall be drilled to the specified diameter and to the depth shown on the plans. Equipment designed to drill multiple holes simultaneously will only be allowed provided such equipment causes no damage to existing pavement. The holes shall be blown clean and allowed to dry. The holes shall be injected with an approved epoxy or polyester bonding agent in accordance with Sec 1039.30 and shall fill the voids around the bar. The bonding agent shall be thoroughly mixed in accordance with the manufacturer's recommendations prior to injection into the holes. The bonding agent shall be injected into the hole by inserting the injection device to the back of the hole and slowly withdrawing the device while dispensing sufficient material to completely fill the void around the bar when inserted. Other methods may be used as approved by the engineer. The contractor shall use a method to prevent the bonding agent from flowing from the hole during placement of the bar and to create an effective face at the entrance of the hole. The bar shall be inserted into the hole with a twisting motion so the material in the back of the hole is forced up and around the bar. The bars shall be placed parallel to the surface and the centerline of the traveled way and shall not vary more than 1/4 inch (6 mm) in alignment. Bars shall be firmly seated prior to placing concrete. Where welded wire fabric will be required, the wire fabric shall be placed 3 inches ± 1/2 inch (75 mm ± 13 mm) below the surface of the concrete patch.

613.10.2.3 All material, proportioning, air-entraining, mixing, slump and transporting of concrete shall be in accordance with Sec 501 as applicable to pavement concrete, except as follows. The maximum slump shall be 3 1/2 inches (90 mm). Gradation D or E may be substituted for Gradation F when Gradation F is specified. The contractor shall provide a trial mix to determine the approximate cure time needed to achieve the required compressive strength. Compressive specimens shall be prepared in accordance with current MoDOT methods and cured to simulate actual field conditions. Testing of compressive specimens shall be performed by methods and at facilities acceptable to the engineer. A new trial mix may be required if the engineer determines the field conditions vary substantially from trial mix conditions.

613.10.2.3.1 When the repair is to be made and opened to traffic after 24 hours, the concrete shall be in accordance with the following requirements:

Property	Existing Slab Design Thickness	Requirement
Compressive Strength in 24 hours	8 in. (200 mm) or less 9 in. (225 mm) 10 in. (250 mm) or more	3000 psi (21 MPa), min. 2700 psi (18.6 MPa), min. 2000 psi (14 MPa), min.
Compressive Strength in 28 days	--	4000 psi (28 MPa), min.

[a]The cure time shall be the time determined to reach the 24-hour compressive strength. The roadway shall not be opened to traffic until the 24-hour compressive strength has been attained.

613.10.2.3.2 When the repair is to be made and opened to traffic in less than 24 hours, the concrete shall be in accordance with the following requirements:

Property	Existing Slab Design Thickness	Requirement
Compressive Strength in 4 hours[a]	8 in. (200 mm) or less 9 in. (225 mm) 10 in. (250 mm) or more	3000 psi (21 MPa), min. 2700 psi (18.6 MPa), min. 2000 psi (14 MPa), min.
Compressive Strength in 28 days	--	4000 psi (28 MPa), min.

[a]The cure time shall be the time determined to reach the 4-hour compressive strength. The roadway shall not be opened to traffic in less than 24 hours until the 4-hour compressive strength has been attained.

613.10.2.3.2.1 The concrete may contain Type III cement, calcium chloride, an accelerator or other admixtures approved by the engineer.

613.10.2.3.2.2 When the ambient temperature may drop below 60 F (16 C), the temperature of the concrete at the time of placement shall be no lower than 80 F (27 C).

613.10.2.4 If the concrete pavement has been resurfaced and where no additional structure is to be added to the existing overlay, or where the existing bituminous overlay is to be removed by milling, the repaired area shall be filled to the surface of the existing bituminous overlay with Portland cement concrete.

613.10.2.5 If the concrete pavement has been resurfaced and additional lifts are to be added over the existing overlay, the repair area shall be filled with Portland cement concrete to the surface of the underlying concrete pavement, and the remaining area shall be filled with an approved hot-mix asphalt to the existing bituminous overlay surface. The hot-mix asphalt shall be placed in accordance with the specifications for that mix.

613.10.2.6 When the concrete pavement requires all milled areas to be resurfaced in the same work day prior to opening the pavement to traffic, pavement repairs identified after milling will be marked for future repair, and the area shall be resurfaced as planned for that work day. No additional lifts of hot-mix asphalt will be allowed until the marked pavement is repaired. The pavement repair shall be performed in accordance with Sec 613.10.2.5.

613.10.2.7 Immediately after finishing and as soon as marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured in accordance with one of the following methods.

613.10.2.7.1 If the existing pavement has been or is to be resurfaced, an asphalt emulsion shall be applied at a rate of 0.1 gallon per square yard (0.50 L/m^3), or as directed by the engineer.

613.10.2.7.2 If the existing pavement surface is concrete and will not be resurfaced, curing shall be in accordance with Sec 502.

613.10.2.7.3 If Type III cement is selected by the contractor in accordance with Sec 613.10.2.3.2.1, insulated curing mats, approved by the engineer, shall be used throughout the curing period.

613.10.2.8 Pavement repair areas shall not be opened to traffic until the minimum cure time, as determined from an approved trial mix in accordance with Sec 613.10.2.3, has elapsed and the minimum compressive strength specified for that cure time has been attained.

613.10.2.9 Where subsequent resurfacing operations are not specified, both transverse ends of all new Portland cement concrete repairs shall be sawed and sealed as shown on the plans in accordance with Sec 1057.

613.10.3 Method of Measurement.

613.10.3.1 Measurement for full depth sawing will be made to the nearest linear foot (0.5 m) of perimeter diamond saw cuts and of internal saw cuts at 6 foot or greater intervals.

613.10.3.2 Measurement for drilling dowel or tie bar holes and furnishing and installing dowels or tie bars will be made per dowel or tie bar.

613.10.3.3 Measurement for furnishing and placing Portland cement concrete and wire fabric, if applicable, will be made to the nearest 1/10 square yard (0.1 m^2).

613.10.3.4 Measurement of subgrade compaction will be made to the nearest square yard (m^2).

613.10.3.5 Measurement of aggregate base will be made to the nearest square yard (m^2).

613.10.4 Basis of Payment. Accepted quantities of full depth pavement repair will be paid for at the contract unit price for each of the pay items included in the contract. No direct payment will be made for aggregate base material used to replace unstable subgrade.

SECTION 613.20 CLASS A PARTIAL DEPTH PAVEMENT REPAIRS

613.20.1 Description.

613.20.1.1 Class A partial depth pavement repair shall consist of repairing spalled areas or reestablishing joints or cracks in concrete pavement. Reestablishment of a joint or crack shall consist of removing concrete on each side of the joint or crack, placing a joint forming insert to reestablish the joint or crack, and filling the area with concrete. This work shall be performed on concrete pavements that have not been resurfaced and are either not to be resurfaced as part of the contract work or the resurfacing is to be less than 3 inches (75 mm) thick.

613.20.1.2 If dowel bars are structurally damaged during the removal process, if the concrete below one half of the slab depth is unsound or damaged during removal, or if the area indicates pumping, movement of the subbase, or structural pavement failure, full depth pavement repair shall be performed in accordance with Sec 613.10.

613.20.2 Material.

613.20.2.1 When the roadway will be required to be opened to traffic within four hours of the repair, one of the following materials shall be used.

613.20.2.1.1 Concrete shall be in accordance with the following requirements. Compressive strength specimens shall be prepared in accordance with current MoDOT methods and cured to simulate actual field conditions. Testing of compressive specimens shall be performed by methods and at facilities acceptable to the engineer. A new trial mix may be required if the engineer determines the field conditions vary substantially from trial mix conditions. The coarse aggregate for the concrete shall be Gradation E or F in accordance with Sec 1005.

Property	Requirement
Compressive Strength in 4 hours [a]	1600 psi (11 MPa), min.
Compressive Strength in 24 hours	4000 psi (28 MPa), min.
Air Content	4 percent, min.
Slump	1 inch (25 mm), max.

[a]The cure time shall be the time determined to reach this compressive strength. The roadway may be opened to traffic when this compressive strength has been attained.

613.20.2.1.2 Epoxy mortars shall be in accordance with Sec 623.

613.20.2.2 When the repair can be protected from traffic for 24 hours or more, concrete shall be in accordance with the following. Coarse aggregate for the concrete shall be Gradation E or F in accordance with Sec 1005.

Property	Requirement
Compressive Strength in 24 hours [a]	1600 psi (11 MPa), min.
Compressive Strength in 7 days	4000 psi (28 MPa), min.
Air Content	4 percent, min.
Slump	1 inch (25 mm), max.

[a]The cure time shall be the time determined to reach this compressive strength. The roadway may be opened to traffic when this compressive strength has been attained.

613.20.2.3 Compressible inserts shall be rectangular and shall have a minimum thickness of 1/4 inch (6 mm). The material shall be preformed fiber expansion joint filler in accordance with Sec 1057 or, if approved by the engineer, styrofoam or asphalt-impregnated fiberboard.

613.20.2.4 Type 2, Class B liquid membrane-forming compounds, in accordance with AASHTO M 148, shall be used for curing the concrete patch material. Prior to use, the contractor shall provide to the engineer the manufacturer's certification that the curing material is in accordance with this specification.

613.20.3 Construction Requirements.

613.20.3.1 Removal of Concrete. Repair limits shall extend beyond the delaminated or spalled areas by 3 to 4 inches (75 to 100 mm). Boundaries of any removal shall be kept square or rectangular. If repair areas are less than 2 feet (0.6 m) apart, the areas shall be combined as one repair. The maximum amount of spalling allowed on the edges of the channel will be 3/8 inch (9 mm). The channel depth shall not exceed half the slab depth. Concrete shall be removed by sawing and chipping or by a milling process. Residue slurry from sawing or milling operations shall be removed in accordance with Sec 622.30.3.8. If the top of dowel

bars are exposed but not structurally damaged, the exposed section of the dowel bar shall be coated with an approved bond breaker.

613.20.3.1.1 Sawing and Chipping. An approved saw, such as a diamond saw, shall be used to make perimeter cuts. The saw cut shall provide a vertical face at the repair edges and shall have a minimum depth of 2 inches (50 mm). Additional saw cuts may be made within the repair area to facilitate chipping removal. The repair area shall be broken out with light pneumatic tools until sound and clean concrete is exposed. The maximum allowable pneumatic hammer weight (mass) for chipping shall be 15 pounds (7 kg). The pneumatic hammer will not be permitted to break through the concrete, and if this occurs, a full depth pavement repair shall be conducted at that location. The concrete around the repair channel shall not be broken. Once the concrete is removed, the bottom of the channel shall be flattened by removing the rocks and burrs with small pneumatic tools.

613.20.3.1.2 Milling. Milling equipment shall be in accordance with Sec 622.10, and shall be equipped with a device for stopping at a preset depth. Milling may be performed either across lanes or parallel to the pavement centerline. After milling, the bottom of the repair area shall be checked by sounding to ensure all unsound material has been removed. Any unsound material remaining shall be chipped free. Pneumatic hammers shall not be used to form the repair area perimeter. The repair boundaries and edges shall be uniform and tapered by milling. If excessive concrete is removed, or if dowel bars or reinforcement are damaged to the extent to require full depth pavement repair, the cost for the repair shall be at the contractor's expense.

613.20.3.1.3 Full Depth Pavement Repair Required. If during the removal of material for partial depth pavement repair the pavement constituted full depth pavement repair in accordance with Sec 613.20.1.2, removal operations shall cease at that location. The contractor may conduct full depth pavement repair at that time, or temporarily patch the area and perform full depth pavement repair at a later date. If the location is opened to traffic prior to the full depth pavement repair, all loose material shall be removed and either a bituminous material approved by the engineer or a concrete mixture in accordance with Sec 613.20.2 shall be used to patch the location. Reestablishing joints or cracks in temporary repairs by sawing will not be required. Material provided for temporary patches shall be provided at the contractor's expense.

613.20.3.2 Cleaning. The exposed faces of the concrete shall be free of loose particles, oil, dust, traces of bituminous material and any other contaminants before repair material is placed. The procedure shall produce a clean, roughened surface, such as can be produced by sandblasting or high pressure water blasting. All residue shall be removed with air blasting equipment just prior to placement of material. The air from the air blasting equipment shall be free of contaminants.

613.20.3.3 Joint and Crack Preparation.

613.20.3.3.1 Transverse Joints and Cracks. When placing a partial depth pavement repair directly against a transverse joint or crack, a compressible insert shall be placed against the joint or crack to form a bond breaker between the patch material and joint or crack. A pliable material shall be used to reform cracks along the existing paths. The new joint or crack shall be formed to the same width as the existing joint or crack. The compressible insert shall be placed into the existing joint to a minimum depth of one inch (25 mm) below the bottom of the repair and shall extend a minimum of 3 inches (75 mm) beyond each end of the prepared repair boundaries.

613.20.3.3.2 Longitudinal and Centerline Joints. When placing a partial depth pavement repair directly against the centerline or an adjacent lane joint, a compressible insert, a thin

polyethylene strip no less than 1/8 inch (3 mm) thick or asphalt impregnated roofing felt shall be placed along the joint prior to placing the patching material.

613.20.3.3.3 Shoulder Joints. When placing a partial depth pavement repair along a lane and shoulder joint, the repair edge shall be formed if the shoulder is either soil, aggregate or bituminous material. The form shall be placed even with the surface and slightly below the repair depth. If the shoulder is concrete, then the repair interface at the joint shall be in accordance with Sec 613.20.3.3.2.

613.20.3.3.4 Reestablishment of Joint and Cracks. At locations where repairs include existing pavement joints, both longitudinal and transverse, the initial reestablishment of the joint in the plastic concrete shall be accomplished with an approved cutter bar or preformed fiber expansion joint filler and shall be made to the same width as the existing joint. Existing cracks shall be reestablished using a compressible insert of a width equal to the existing crack width, except the insert shall be no less than 1/4 inch (6 mm) thick. The material insert shall be placed into the existing joint or crack to a minimum depth of one inch (25 mm) below the bottom of the repair, shall extend the full length of the joint or crack and shall extend to the top of the proposed pavement profile. The material shall prevent the concrete from flowing into the existing joint or crack. Sawing will not be permitted.

613.20.3.4 Material Placement.

613.20.3.4.1 Bonding Material. Bonding material or a light mist with water may be used. Bonding material shall be applied in a thin even coat, shall cover the entire area, including the repair walls, shall overlap the pavement surface and shall be in accordance with the following.

613.20.3.4.1.1 For Sec 613.20.2.1.1 concrete, Type II or Type III epoxy resin material in accordance with Sec 1039 or grout in accordance with Sec 613.20.3.4.1.2 shall be used. When epoxy material is used, the concrete shall be placed while the epoxy is still tacky. If the epoxy sets prior to placement of the concrete, the hardened epoxy material shall be removed and the pavement repair area shall be cleaned in accordance with Sec 613.20.3.2.

613.20.3.4.1.2 For Sec 613.20.2.2 concrete, mortar for grout shall be in accordance with Sec 1066, except the grout shall consist of equal parts of cement and sand. If the grout dries prior to placing the concrete, the dried or hardened grout shall be removed and the pavement repair area shall be cleaned in accordance with Sec 613.20.3.2.

613.20.3.4.1.3 For epoxy mortar, a neat low viscosity epoxy in accordance with Sec 623.20 shall be used.

613.20.3.4.2 Placement of Repair Material. Epoxy mortar shall not be used to repair spalls caused by reinforcing steel corrosion. No standing water shall be present at the time of placement of the material. Retempering of the concrete mixture with water will not be permitted. Concrete material shall be placed into the channel and consolidated with a small spud vibrator. Vibrators with diameters greater than one inch (25 mm) will not be permitted. Care shall be taken not to touch the compressible insert with a vibrator. On very small repairs and as approved by the engineer, hand tools may be used to work the repair material and attain adequate consolidation. Epoxy mortar components shall be handled, prepared and mixed in accordance with Sec 623. Any segregated areas shall be removed and replaced at the contractor's expense.

613.20.3.4.3 Finishing and Texturing. Repair material shall be finished to match the cross section of the existing pavement. The repair material shall be screed from the center of the repair out to the repair boundaries. Any excess mortar from finishing may be used to fill any

saw cut run-outs that extend beyond the repair perimeter. After finishing, the repair shall be appropriately textured to approximate the texture of the existing pavement.

613.20.3.4.4 Sealing and Curing. The repair and slab interface shall be sealed by painting the repair perimeter with a 1:1 cement-water grout. Concrete repair material shall be cured in accordance with Sec 502.6.1, except a double application of curing material in accordance with Sec 613.20.2.4 shall be placed over the repaired area. Epoxy mortar shall be cured in accordance with Sec 623.

613.20.3.5 Resealing Joints and Cracks. After the concrete has initial set, all longitudinal and transverse joint and crack inserts shall be removed by sawing. All joints and cracks shall be sawed at least as wide as the rest of the joint or crack in the adjoining concrete, and the underlying concrete pavement. All transverse joints and cracks shall be sawed to a minimum depth of 3/8 inch (9 mm) below the pavement surface. All longitudinal joints abutting to an adjoining concrete pavement lane shall be sawed to a depth equal to 1/2 inch (12.5 mm) less than one-half of the pavement thickness. Where concrete extends into the shoulder, the saw cut shall be to the depth of the patch. The reservoir shall then be filled with a hot-poured, elastic-type concrete joint sealer in accordance with Sec 1057.

613.20.3.6 Opening to Traffic. For repairs using concrete as the patching material, traffic shall not be permitted on the repaired pavement until the minimum cure time, as determined from an approved trial mix in accordance with Sec 613.20.2, has elapsed and the minimum compressive strength specified for that cure time has been attained. For epoxy resin mortars or epoxy concrete, traffic shall not be permitted on the repaired pavement until the rapid set concrete has attained a minimum compressive strength of 1600 psi (11 MPa), but shall be a minimum of two hours after placement.

613.20.3.7 Acceptance. All pavement repairs will be sounded by the engineer prior to acceptance. Sounding will not be performed until the repair material has reached design compressive strength or the repair has been open to traffic for a minimum of two days. If sounding indicates unsound material, the entire pavement repair shall be removed to the limits designated by the engineer and replaced by the contractor at the contractor's expense.

613.20.4 Method of Measurement.

613.20.4.1 Measurement for repairing spalled areas, cracks or joints will be made to the nearest 1/10 square yard (0.1 m^2). Any material removed beyond the repair area designated by the engineer due to the removal methods used by the contractor will not be included in the measurement for pavement repair. Measurement of all concrete material furnished in the repair of spalled areas, cracks or joints will be made to the nearest 1/10 cubic yard (0.1 m^3). Measurement of the saw cut for resealing joints and cracks in accordance with Sec 613.20.3.5 will be made to the nearest linear foot (0.5 m).

613.20.4.2 If an area designated for partial depth pavement repair requires full depth pavement repair in accordance with Sec 613.20.1.2, measurement for material removed as part of the partial depth pavement repair work at that location will be made to the nearest 1/10 square yard (0.1 m^2).

613.20.5 Basis of Payment. The accepted quantities for Class A partial depth pavement repair will be paid for at the contract unit price for each of the pay items included in the. No separate payment will be made for any cost associated with making perimeter saw cuts for Class A partial depth pavement repairs. Full depth pavement repairs required due to negligence by the contractor will be at the contractor's expense. All other full depth pavement repairs will be paid for in accordance with Sec 613.10.

SECTION 613.30 CLASS B PARTIAL DEPTH PAVEMENT REPAIRS

613.30.1 Description.

613.30.1.1 Class B partial depth pavement repair shall consist of removing areas of unsound concrete or bituminous material to a maximum depth of one half of the concrete pavement thickness and replacing the unsound material with an approved bituminous mixture. This work shall be performed on projects that include resurfacing as part of the contract.

613.30.1.2 If dowel bars are structurally damaged during the removal process, if the concrete below one half of the slab depth is unsound or damaged during removal, or if the area indicates pumping, movement of the subbase or structural pavement failure, full depth pavement repair shall be performed in accordance with Sec 613.

613.30.2 Material. The material used for Class B partial depth pavement repairs shall be either the bituminous surface mix specified in the contract for resurfacing the existing pavement or a bituminous commercial mix in accordance with Sec 401.5.3.

613.30.3 Construction Requirements.

613.30.3.1 Removal of Bituminous and Concrete Material.

613.30.3.1.1 At areas shown on the plans or where unsuitable material is exposed during coldmilling operations and identified by the engineer to be repaired, all loose and unsuitable bituminous material shall be removed by milling or other approved methods. Concrete material shall be removed in accordance with Sec 613.20.3.1. Around the perimeter of the repair, the sides shall be relatively vertical, and concrete surfaces shall have a roughened face, such as can be produced by milling, sandblasting or high pressure water blasting. The minimum depth of the repair shall be 2 inches (50 mm). The area shall be cleaned to remove loose material and shall have a relatively uniform depth. If the top of dowel bars are exposed but not structurally damaged, the exposed section of the dowel bar shall be coated with an approved bond breaker.

613.30.3.1.2 If during the removal of material for partial depth pavement repair, the pavement constitutes full depth pavement repair in accordance with Sec 613.30.1.2, removal operations shall cease at that location. The contractor may conduct full depth pavement repair at that time, or the contractor may temporarily patch the exposed area in accordance with Sec 613.20.3.1.3, and perform full depth pavement repair at a later date.

613.30.3.2 Cleaning. The exposed faces of the concrete shall be free of loose particles, dust and any other contaminants before repair material is placed. The procedure shall produce a clean, roughened surface, such as can be produced by sandblasting or high pressure water blasting. All residue shall be removed with air blasting equipment just prior to placement of material. The air from the air blasting equipment shall be free of contaminants.

613.30.3.3 Placement of Repair Material. The repair area shall be suitably tacked on the sides and bottom to ensure bonding of any remaining loose material, as well as bonding of the repair material. There shall be no ponding of the tack liquid at the time the area is filled. The repair area shall be filled with an approved bituminous surface mixture, and thoroughly compacted over the entire repair area to a density approved by the engineer. Areas greater than 2 inches (50 mm) in depth shall be filled in two lifts, each thoroughly compacted. Reestablishing of joints by sawing will not be required.

613.30.4 Method of Measurement.

613.30.4.1 Measurement of Class B partial depth pavement repairs for removing material will be made to the nearest 1/10 square yard (0.1 m^2). Any material removed beyond the repair area designated by the engineer due to the removal methods used by the contractor will not be included in the measurement for pavement repair. Measurement for furnishing and placing the bituminous material will be made to the nearest 0.1 ton (0.1 Mg).

613.30.4.2 If an area designated for partial depth pavement repair requires full depth pavement repair in accordance with Sec 613.30.1.2, measurement for material removed as part of the partial depth pavement repair work at that location will be made to the nearest 1/10 square yard (0.15 m^2).

613.30.5 Basis of Payment. The accepted quantities for Class B partial depth pavement repair will be paid for at the contract unit price for each of the pay items included in the contract. Full depth pavement repairs required due to improper means and methods by the contractor will be at the contractor's expense. All other full depth pavement repairs will be paid for in accordance with Sec 613.10.

SECTION 613.40 DOWEL BAR RETROFIT

613.40.1 Description of Work. This work shall consist of sawing partial depth slots across cracks, cleaning the slots, placing dowel bars in the slots, placing a joint forming insert to reestablish the crack and backfilling the slots with concrete.

613.40.2 Material.

613.40.2.1 Repair Material. Rapid set concrete patching material shall be used. Prior to use, the material shall be approved by Construction and Materials. Material having completed current testing through AASHTO's NTPEP will be considered for qualification upon submittal of a written request by the manufacturer with accompanying documentation. The material shall be handled, prepared and mixed in accordance with the manufacturer's recommendations. The contractor shall supply a manufacturer's certification to the engineer for each lot of material furnished. Certification shall include the name of the manufacturer and a manufacturer's certification statement that the material supplied is the same as the material that was qualified.

613.40.2.2 Dowel Bars. Dowel bars shall be 1 1/2 x 18 inches (38 x 450 mm) and in accordance with Sec 1057, except the entire dowel bar shall be coated.

613.40.2.3 Expansion Caps for Dowel Bars. Caps shall be tight fitting and made of 1/4-inch (6 mm) thick non-metallic material that will allow 1/4 inch (6 mm) movement at each end of the dowel bar.

613.40.2.4 Joint Insert. To re-establish the crack, a compressible insert, in accordance with Sec 613.20.2.3, shall be used. The material shall fit tight around the dowel bar and to the bottom and edges of the slot. The material shall be capable of remaining in a vertical position and tight to all edges during placement of the repair material to prevent the concrete backfill from flowing into the existing crack and pavement voids.

613.40.2.5 Bar Chairs. Bar chairs may be metal epoxy-coated chairs or a non-metallic material.

613.40.3 Construction Requirements.

613.40.3.1 Preparation of Slots. Two saw cuts shall be made in the pavement to outline the longitudinal sides of each dowel bar slot. The slots shall be sawed to a depth and length that

allows the center of the dowel to be placed at mid-depth in the pavement slab. The slots shall be 2 1/2 to 4 inches (63 to 100 mm) wide. The contractor shall provide a method, approved by the engineer, that will align the slots parallel to centerline of the roadway with a maximum variation of 1/8 inch (3 mm) from a true parallel line. Slots in a wheel path shall be created by using saws with gang-mounted diamond blades, capable of simultaneously making six saw cuts for three dowel bar slots at the desired slot spacing. Equipment shall not cause damage to the existing pavement. All saw slurry shall be removed from the slot and pavement. No water residue or paste shall be allowed to flow onto lanes open to traffic or into closed drainage systems. Pneumatic hammers used to remove the concrete remaining between the saw cuts shall not be larger than 15 pounds (7 kg). If the concrete removal operations cause damage to pavement that is to remain, the concrete removal operations shall be discontinued and shall not resume until the contractor has taken corrective measures. The pneumatic hammer will not be permitted to break through the concrete, and if this occurs, a full depth pavement repair shall be conducted at the contractor's expense. The bottom of slots shall be flat. The edges of the slots shall be cleaned by blasting to produce a rough surface. Blasting operations shall not damage the surrounding pavement. The newly exposed concrete surface shall be free of spalls, burrs, latence and all contaminants detrimental to achieving an adequate bond. The maximum amount of spalling allowed on the edges of the slots will be 3/8 inch (9 mm). Slots shall be long enough to place the dowel bars in the slots without the ends of the bars hitting the curved ends of the saw cut.

613.40.3.1.1 After the construction of a slot, the pavement shall not be opened to traffic until all six retrofit dowel bars are in place, cured, and the work is completed at that location. The tires of construction vehicles will not be permitted to travel on slots where concrete has been removed.

613.40.3.1.2 Multiple saw cuts parallel to the centerline may be sawed to allow removal of material from the dowel bar slots and to provide a level surface for the feet of the dowel bar chairs.

613.40.3.1.3 All slots shall be cleaned with moisture-free, oil-free, compressed air to remove any remaining dust, residue, debris and moisture. The contractor shall then seal the existing transverse joint and all cracks at the bottom and the sides of the dowel bar slot with an approved caulking sealant to prevent any repair material from entering into these areas.

613.40.3.2 Placement of Dowel Bars, Joint Inserts and Repair Material.

613.40.3.2.1 Prior to inserting a dowel bar in a slot, expansion caps shall be placed on each end of the bar. A dowel bar chair shall hold the bar firmly centered in the slot and at a minimum of 1/2 inch (13 mm) above the bottom of the dowel slot. The dowel bar chairs shall not allow movement of the dowel.

613.40.3.2.2 When placing the dowel bar in the slot, care shall be taken to avoid getting any graphite grease onto the sides or bottom of the slot. If the debonding agent on the dowel bar contaminates any of the surfaces of the slot, the dowel bar shall be removed and the slot sandblasted to remove the contamination.

613.40.3.2.3 The dowel bar shall be inserted into the slot such that the chair legs are in the saw cut kerfs at the bottom of the slot. The bars shall vary no more than 1/4 inch (6 mm) from the pavement surface and shall be parallel to the centerline of the pavement. Bars shall be firmly centered in the slot at the midpoint of the pavement slab. The legs of the bar chairs shall be snug against the slot wall.

613.40.3.2.4 A joint insert shall be placed into the slot as a filler material to maintain the crack as shown on the plans. When in place, the insert shall extend from the bottom of the slot

to no more than 1 1/2 inches (38 mm) from the surface of the pavement, with half the dowel length extending on each side of the insert. If for any reason the insert or dowel bars shift during placement of the repair material, the work will be rejected and shall be redone at the contractor's expense.

613.40.3.2.5 Just prior to placement of the repair material, one or more passes of an air blast shall be used to provide a dust free, clean slot.

613.40.3.2.6 The rapid set concrete patching material shall be placed in the slot, consolidated, textured and cured as recommended by the manufacturer.

613.40.3.3 Resealing Cracks. After the concrete has initial set, the joint insert shall be removed to a minimum depth of 3/8 inch (9 mm) below the pavement surface by sawing. The reservoir shall then be filled with hot-poured, elastic-type, concrete joint sealer in accordance with Sec 1057.

613.40.3.4 Opening to Traffic. Traffic shall not be permitted on the repaired pavement until the rapid set concrete patching material has attained a minimum compressive strength of 1600 psi (11 MPa), but shall be a minimum of 2 hours or the time recommended by the manufacturer.

613.40.4 Basis of Payment. The accepted quantity for dowel bar retrofit will be paid for at the contract unit price per dowel bar, complete and accepted in place.