ENGINEERING POLICY BALLOT

Effective: April 1, 2020

Level 2

Level two revisions require the approval of the **Assistant Chief Engineer** and the **Federal Highway Administration** only. The **Senior Management Team** is encouraged to review the content and provide comment to the appropriate director. For all other parties, these revisions are posted for information only.

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Effective: April 1, 2020

Issue 1: Deck Rehabilitation

Approval: **Level 2 – Assistant Chief Engineer**

Sponsor: Boyd Denson- BR

Summary: This revision updates the standard specifications to current deck rehabilitation practices that have previously been included in contracts via job special provisions (JSPs). These revisions focus on adding fixed cost items for seven supplementary wearing surfaces, blasting abrasives removal/containment and wearing surface removal for hydro demolition, wearing surface material for low slump/latex modified/silica fume/latex modified very early strength/CSA cement/steel fiber reinforced/polyester polymer concretes, and method of measurement for these wearing surfaces. Sec 623 is being renamed to Polymer Products and will now include MMA polymer slurry wearing surface specifications. Revisions to Sec 704 are expanded clarifications for deck repairs and includes additional information for deck sealing, crack filler, and other repairs after hydro demolition. Sec 1039 is being renamed Polymer Products for consistency with Sec 623 and includes additional specifications for MMA polymer slurry and polyester polymer wearing surface materials.

Publication: Sec 109, 202, 216, 505, 623, 704, 1039

SECTION 109

MEASUREMENT AND PAYMENT

109.16 Fixed Cost Items. The following fixed prices shall be used when referenced in the specifications:

Sec	Item No.	Item of Work	Unit	Fixed Price
201.4.3	201-30.00	Clearing and Grubbing	Acre	$3,500.00
203.9.4	203.20.00	Class C Excavation ≤ 500 cy	cy	$75.00
206.6.2	206-36.00	Supplemental Foundation Test Holes	ft	$6.00
206.6.3.1	206-10.03	Class 1 Excavation in Rock	cy	$120.00
206.6.3.2	206-20.03	Class 2 Excavation in Rock	cy	$170.00
206.6.3.3	206-31.00	Class 3 Excavation in Rock	cy	$85.00
206.6.3.4	206-34.00	Class 4 Excavation in Rock	cy	$85.00
214.5.1.2	214-20.00	Furnishing Rock Fill	cy	$15.00
303.5.1.2	303-06.00	Furnishing Rock Base Material	sy	$10.00
401.14	401-05.00	Sample of Compacted Plant Mix Bituminous Pavement	Each	$75.00
403.23.2	403-05.00	Sample of Compacted Asphaltic Concrete Pavement	Each	$75.00
505.10.14	505-00.04	Supplementary Wearing Surface Material (Low Slump Concrete)	cy	$800.00
505.20.14	505-00.04	Supplementary Wearing Surface Material (Latex Modified Concrete)	cy	$700.00
505.30.14	505-00.04	Supplementary Wearing Surface Material (Silica Fume Concrete)	cy	$800.00
505.40.15	505-00.04	Supplementary Wearing Surface Material (Latex Modified Very Early Strength Concrete)	cy	$900.00
505.50.15	505-00.04	Supplementary Wearing Surface Material (CSA Cement Very Early Strength Concrete)	cy	$700.00
505.60.9	505-00.04	Supplementary Wearing Surface Material (Steel Fiber Reinforced Concrete)	cy	$500.00
505.70.12	505-00.04	Supplementary Wearing Surface Material (Polyester Polymer Concrete)	cy	$900.00
611.30.5.1	611-30.10	Furnishing Type 1 Rock Blanket	cy	$24.00
611.30.5.1	611-30.20	Furnishing Type 2 Rock Blanket	cy	$25.00
701.7.7	701-15.00	Concrete Coring	lf	$100.00
618.3	618-10.20	Additional Mobilization for Seeding	Each	$600.00
~~703.5.1~~	~~**Concrete Fill > 2 cy**~~			
703.5.1	703-20.02	Class B Concrete (Misc) (Concrete Fill > 2 cy)	cy	$500.00
~~703.5.1~~	~~**Concrete Fill < 2 cy**~~			
703.5.1	703-20.02	Class B Concrete (Misc) (Concrete Fill ≤ 2 cy)	cy	$750.00
704.6	706-10.00	Reinforcing Steel	lb	$2.00

SECTION 202

REMOVAL OF ROADWAYS AND BUILDINGS

202.1 Description. This work shall consist of the removal and disposal of all existing improvements from the right of way and within the limits of any construction area outside the right of way, except improvements designated or permitted to remain in place or to be removed under other items of work. These specifications will apply to all removal work performed by the contractor.

202.2 General Requirements.

202.2.1 ~~Containment and~~ Disposal of Material. ~~All abrasives used in blasting activities shall be collected using a containment system or enclosure to prevent the release of material to the environment.~~ All improvements not designated to remain shall be removed or disposed of by the contractor as required. The work may involve the generation of excess material, which may be solid waste under the definitions of the MDNR Solid Waste Management Program. The contractor shall dispose of solid waste in accordance with the Missouri Solid Waste Management Law and implementing regulations, 10 CSR 80.

202.3.1.3 All abrasives used in blasting activities, and the material removed in the blasting process, shall be removed from the project and disposed of by the contractor in accordance with all applicable federal and state laws.

202.2.1.1 Regulated solid waste, including waste tires, shall be handled, transported and disposed of in accordance with applicable regulations. Documentary proof of proper transport and disposal of this waste, including transport forms, disposal forms, scale tickets, cancelled checks and receipts, shall be provided to MDNR and to the engineer prior to acceptance of the work.

202.2.1.2 Material designated for use elsewhere shall not be removed from the project. Open burning of material shall be conducted in accordance with Sec 201.2.5.1. Uncontaminated underground storage facilities not requiring removal shall be dewatered, filled with sand or grout to within one foot of the top of the facility, and crushed.

202.2.2 Damaged Items. Any item damaged by the contractor's operations that is designated to remain in place, to be used elsewhere, or to be used by the public or an adjoining property owner, shall be repaired or replaced at the contractor's expense, in a manner satisfactory to the engineer in accordance with Sec 107.12.

202.2.3 Dust and Emissions Control. All operations during demolition and removal shall be adequately controlled to prevent dust and visible emissions, unless otherwise approved by the engineer. All measures taken shall be provided by the contractor at the contractor's expense unless specified otherwise.

202.2.4 Salvage. All material designated in the contract to be salvaged for Commission use from existing structures or improvements shall be removed without damage, in sections that may be readily handled, transported and stored as approved by the engineer. Unless otherwise designated in the contract, all coldmilled material, existing guardrail, and guard cable material designated for removal shall become the property of the contractor. All buildings, material

asphalt wearing surface or concrete wearing surface from the bridge deck as shown on the plans or as directed by the engineer.

216.30.2 Removal Requirements.

216.30.2.1 All material and residue shall be removed. Staining will be permitted. The equipment and procedures used for removal shall be such that no damage will be done to the existing concrete deck. Any epoxy patches encountered shall be completely removed to sound, natural concrete. Excessive tearing of the deck surface shall require immediate correction.

216.30.2.1.1 When a concrete or asphalt wearing surface is to be installed, prior to the removal of the wearing surface, the contractor shall determine the actual depth of the existing wearing surface with sufficient examination to permit an accurate determination of any required supplementary wearing surface material for the new wearing surface.

216.30.2.2 When a concrete wearing surface is to be installed, the removal of the wearing surface plus the amount of deck as shown on the plans or to the adjusted depth described in Sec 216.30.2.2.1 shall produce a very rough texture that is acceptable to the engineer as a bondable surface for the new concrete wearing surface or as a starting profile for total surface hydro demolition. The removal process shall not produce a polished or slick surface.

216.30.2.2.1 Prior to removal of the wearing surface, the contractor shall verify the depth of the top mat of reinforcing steel within the deck. If the depth of the reinforcing steel is less than 0.5 inch, the cold milling depth shall be reduced to avoid damage to the reinforcing steel. Any reinforcing steel damaged by the milling operation shall be repaired or replaced at the contractor's expense.

216.30.3 Method of Measurement.

216.30.3.1 Final measurement of the removal of seal coat ~~and~~ or wearing surface ~~removal~~ will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, removal of bonded seal coat or polymer wearing surface, asphalt wearing surface and concrete wearing surface will be measured to the nearest square foot based on measurement longitudinally from end of slab to end of slab and transversely from roadway face of curb to roadway face of curb. The revision or correction will be computed and added to or deducted from the contract quantity. No measurement will be made for removal of unbonded seal coat or polymer wearing surface.

216.30.4 Basis of Payment.

216.30.4.1 The accepted quantities of the removal of ~~S~~seal coat ~~and~~ or wearing surface ~~removal~~ will be paid for at the contract unit price, except that all costs incurred by the contractor while removing the unbonded seal coat or unbonded polymer wearing surface will be considered completely covered in the contract unit price for other items.

SECTION 216.40 REMOVAL AND STORAGE OF EXISTING BRIDGE RAIL~~S~~.

216.40.1 Description. This work shall consist of disassembling, removing, transporting and storing existing bridge rails at the location specified in the contract documents or as directed by the engineer.

216.40.2 Storage Requirements. Storage shall be by stacking in a neat and orderly manner on contractor furnished timbers. The contractor shall notify and make arrangements with the engineer a minimum of 24 hours prior to commencing the storage of these materials. The

216.100.5 Basis of Payment. Removal of existing expansion joint seal or sealant will be paid for at the contract unit price.

SECTION 216.110 TOTAL SURFACE HYDRO DEMOLITION.

216.110.1 Description. This work shall consist of removal of all existing deck repairs followed by the selective removal of all unsound original concrete over the entire top surface of the bridge deck, and establishment of a highly rough and bondable surface, with a single pass of hydro demolition equipment. Existing deck repairs are defined as any sound or unsound repairs previously made to the original deck. Unsound original concrete is defined as existing bridge deck concrete that is deteriorated, spalled or as determined by the engineer to be unacceptable.

216.110.2 Material. Water used in the hydro demolition shall be in accordance with Sec 1070.

216.110.3 Removal and Repair Prior to Hydro Demolition.

216.110.3.1 Removal of Existing Deck Repair.

216.110.3.1.1 Following scarification of the deck or removal of an existing wearing surface and prior to hydro demolition, the entire deck surface shall be thoroughly cleaned by high pressure water blasting with sufficient pressure to remove all debris. After cleaning, all existing deck repairs will be measured by the engineer and marked for removal over the full deck.

216.110.3.1.2 For bridges without special repair zones, prior to hydro demolition, the contractor shall remove all sound and unsound existing deck repairs using conventional hand/mechanical equipment in accordance with Sec 704.4.

216.110.3.1.3 For bridges with special repair zones, following the completion of deck repair in all special repair zones and prior to hydro demolition, the contractor shall remove all sound and unsound existing deck repairs outside special repair zones using conventional hand/mechanical equipment in accordance with Sec 704.4.

216.110.3.1.4 Removal shall not include any unsound original bridge deck concrete.

216.110.3.1.5 Following removal of existing deck repairs, all debris shall be removed from the deck prior to hydro demolition, at no additional cost.

216.110.3.2 Zoned Conventional Deck Repair (if specified in the contract).

216.110.3.2.1 Prior to hydro demolition, the deck shall be repaired inside special repair zones as called for in the contract plans in accordance with Sec 704.

216.110.3.2.2 Hydro demolition shall not move forward until the repairs in all special repair zones are complete and properly cured.

216.110.4 Total Surface Hydro Demolition.

216.110.4.1 Environmental Compliance.

216.110.4.1.1 Prior to the start of any bridge repair work, the contractor shall submit to the engineer for review an Environmental Compliance Plan (ECP) that ensures compliance with all federal, state, and local environmental laws and regulations. The ECP shall include specific details of the contractor's plan for containment, filtering, and disposal of water, slurry, and other debris, including all best management practices (BMPs) that the contractor plans to utilize to prevent environmental pollution and protect the waters of the state.

216.110.4.1.2 All drains, joints, and other locations where discharge water could exit the deck shall be blocked in order to direct runoff to a central collection and filtering location, as designed by the contractor. When runoff is allowed to be dispersed adjacent to the bridge, BMPs shall be utilized to contain and filter the slurry to prevent the discharge of slurry or other contaminants.

216.110.4.1.3 No direct payment will be made for compliance with this ECP, including, but not limited to, containment of the water and slurry, installing, maintaining, and removing the BMPs, filtering, and disposal of all waste materials.

216.110.4.2 Equipment.

216.110.4.2.1 General. The hydro demolition process shall consist of a water supply system, a high pressure water pumping system, and a demolition type unit. The demolition unit shall be robotic, computerized, and self-propelled, utilizing a high pressure water jet stream that is capable of removing concrete to the desired depths specified with a single pass of the unit, including the selective removal of all unsound original concrete. It shall also be capable of cleaning rust and concrete particles from all exposed reinforcing steel. The resulting concrete surface profile shall be one that is highly rough and bondable.

216.110.4.2.1.1 The hydro demolition equipment shall provide shielding to ensure containment of all dislodged concrete within the removal area in order to protect the traveling public and work crew from flying debris on, adjacent to, and below the work site.

216.110.4.2.1.2 Vacuum equipment shall be utilized for clean-up of hydro demolition debris. This equipment shall be equipped with fugitive dust control devices and shall be capable of removing wet debris and standing water in the same pass.

216.110.4.2.2 Calibration. The hydro demolition equipment shall be calibrated on a representative sample of sound deck concrete, as directed by the engineer. The calibration will demonstrate the ability to cut to the desired depth or depths, as indicated on the plans, in a single pass. The minimum allowable water pressure shall be 13,000 psi and the maximum water pressure shall not exceed 20,000 psi. The calibration shall accomplish the desired surface roughness, profile, and cutting depth as indicated on the contract plans. The equipment shall then be moved to an area of deteriorated deck, as directed by the engineer, in order to demonstrate the ability to remove all unsound original material. The equipment shall selectively remove all unsound original concrete, avoid the removal of unnecessary sound concrete, and provide a highly rough and bondable surface.

216.110.4.2.2.1 If the equipment does not demonstrate the ability to produce the desired result, as determined by the engineer, the equipment shall be removed from the project and the contractor shall provide other equipment for calibration. No additional contract time or compensation will be allowed for the mobilization of replacement equipment to the work site.

216.110.4.2.2.2 After the contractor has calibrated the equipment settings to the satisfaction of the engineer so that the equipment does selectively remove all unsound original concrete and provide a highly rough and bondable surface, without removing additional sound concrete, the calibration will be approved by the engineer and the contractor shall record the equipment settings as follows:

Water Pressure Gauge	
Water Pressure Gauge Inside Special Repair Zones [a]	
Machine Staging Control (Step)	
Machine Staging Control (Step) Inside Special Repair Zones [a]	

Nozzle Size	
Nozzle Type	
Nozzle Travel Speed	
Water Usage Rate	

[a] Only applicable inside special repair zones on existing cast-in-place concrete box girder, solid slab and voided slab bridges. Not applicable for prestressed concrete or steel beam and girder bridges.

216.110.4.3 Operation.

216.110.4.3.1 After calibration of the equipment, the contractor shall perform total surface hydro demolition over the entire surface of the bridge deck.

216.110.4.3.1.1 For bridges without special repair zones, the settings shall be maintained throughout the operation, unless the desired results are not being attained, in which case re-calibration shall be performed.

216.110.4.3.1.2 For bridges with special repair zones, two separate settings shall be maintained throughout the operation. One set of settings shall be maintained throughout the operation outside special repair zones unless the desired results are not being attained, in which case re-calibration shall be performed. Another set of settings shall be maintained throughout the operation inside special repair zones unless the desired results are not being attained, in which case re-calibration shall be performed.

216.110.4.3.1.3 Calibration shall be required on each bridge and when different equipment is brought to the site for use. The engineer will periodically verify the calibration settings to ensure the desired results are being attained.

216.110.4.3.2 The operator shall minimize the overlap of the individual hydro demolition passes to limit the amount of sound concrete removal.

216.110.4.3.3 When the hydro demolition process is taking place above an area of concern, the contractor shall take measures to protect that area from hydro blasting through the deck, falling debris, water runoff, or any other action that the engineer considers a risk to public safety or a risk of property damage. An area of concern shall include vehicular traffic, boat traffic, pedestrian traffic, parking areas, private property, railroad property or any other area of concern as determined by the engineer.

216.110.4.3.4 Only those vehicles directly required to perform the hydro demolition work and clean-up, or corresponding wearing surface construction equipment, shall be allowed on the bridge deck. Contamination of the deck by construction equipment or any other source shall be prevented.

216.110.4.3.5 The contractor shall clean up the slurry and rubble from the hydro demolition operation as soon as possible following the hydro demolition process. This clean-up shall be completed prior to the drying of the slurry on the deck and reinforcing steel. The contractor shall utilize a vacuum collection type system capable of removing wet debris and water in a single operation. Following the cleaning, the surface shall be free of all debris, loose material, slurry, or cement paste.

216.110.4.4 Incidental Conventional Concrete Removals After Hydro Demolition.

216.110.4.4.1 After the deck has been cleaned and dried, and is free of frost, the engineer will visually inspect and perform a sounding test of the entire deck and identify any unsound original deck material that remains.

216.110.4.4.2 The contractor shall remove all identified unsound original deck material, as well as any areas on the deck that were inaccessible to the hydro demolition equipment. This removal work shall be included in the cost of the hydro demolition.

216.110.4.4.3 All removals after hydro demolition shall be done with pneumatic hammers no heavier than the nominal 35-pound class and operated no more than a 45 degree angle from the horizontal. Use of mechanical equipment for the purpose of chipping shall be kept to the absolute minimum to avoid creating micro-fractures on the surface of the deck.

216.110.4.4.4 Reinforcing Steel Repair. The contractor shall take steps necessary to prevent damage to existing reinforcing steel. All equipment shall be operated in a manner that does not damage the deck, reinforcing steel or superstructure components. Any damage caused by the contractor's equipment or negligence shall be repaired at the contractors expense.

216.110.4.4.4.1 Reinforcing steel that is exposed by the process shall be thoroughly cleaned by sand, shot or hydro blasting to the satisfaction of the engineer.

216.110.4.4.4.2 Reinforcement repair shall be in accordance with Sec 704. Replacement of damaged reinforcing steel may include the removal of additional concrete to adequately anchor reinforcing steel to the appropriate lap splice length in accordance with Sec 706.

216.110.4.4.4.3 No direct payment will be made for additional cleaning of reinforcing steel or for removal of loose concrete from the bars. Replacement of reinforcing steel will be made at the fixed unit price in Sec 109.15, except that no payment will be made for replacement of reinforcing steel cut or broken by the contractor.

216.110.5 Method of Measurement.

216.110.5.1 Measurement for removal of existing deck repair will be made to the nearest square foot. For bridges without special repair zones, measurement will include all sound and unsound existing deck repairs. For bridges with special repair zones, measurement will only include all sound and unsound existing deck repairs outside special repair zones.

216.110.5.2 Measurement for total surface hydro demolition will be per square yard of the bridge deck as specified on the plans or shown in the contract. No final measurement will be made for hydro demolition except for authorized changes during construction or where appreciable errors are found in the contract quantity.

216.110.5.3 Measurement of reinforcing steel replaced due to excess section loss will be made to the nearest 10 pounds.

216.110.6 Basis of Payment.

216.110.6.1 Payment for removal of existing deck repair will be made at the contract unit price.

216.110.6.2 Payment for total surface hydro demolition will be paid for at the contact unit price. Payment includes all work associated with the hydro demolition process including, but not limited to, ECP, equipment calibration, hand chipping curb areas, removal of remaining unsound original concrete, clean-up of debris and slurry, forming for full depth monolithic repairs, and preparation of the deck for concrete wearing surface.

216.110.6.3 Reinforcing Steel Repair. Payment for accepted quantities of reinforcing steel replaced due to excess section loss will be paid for at the fixed contract unit price specified in

Sec 109.15. No payment will be made for replacement of reinforcing steel cut or broken by the contractor.

Slump, inches	0.5~~1/2~~ (±0.5 ~~1/2~~)
~~Percent~~ Fine Aggregate, ~~as Percent~~% of t~~T~~otal a~~A~~ggregate by a~~A~~bsolute v~~V~~olume	50
Cement Content, lb~~s.~~/c~~ubic~~ y~~ard~~	818 to 827

505.10.3.2 The cement content and percent fine aggregate shall not be changed. If total mixing water, including free water in aggregate and liquid admixtures, varies from design mixing water to cause a change in batch volume of more than two percent, a new mix design will be required.

505.10.3.3 A Type A water-reducing admixture will be required.

505.10.3.4 During placement, the mixture shall be compacted to no less than 98 percent of the standard density.

505.10.4 Testing.

505.10.4.1 Slump will be determined in accordance with AASHTO T 119. The sample for slump testing will be taken at the point of placement in the structure.

505.10.4.2 Air content will be determined by the pressure method in accordance with AASHTO T 152.

505.10.4.3 When required, standard density, unit weight, will be determined in accordance with AASHTO T 121. Standard density will be determined for at least each two hours of concrete production or any time significant fluctuations occur within the range of air content or slump.

505.10.4.4 Compressive strength will be determined from at least two 6- by 12-inch cylinders or from at least three 4- by 8-inch cylinders prepared in accordance with AASHTO T 23 and tested in accordance with AASHTO T 22. One set consisting of two cylinders will be made for 28-day compressive strength from each day's production. Cylinders made for determining when to permit traffic will be made at a frequency determined by the engineer, and will be cured in the near vicinity and in the same manner as the bridge deck.

505.10.4.5 Concrete taken as a sample for testing slump and air content shall be wasted and shall not be placed in the deck. If air content or slump test results are not in accordance with specifications, any concrete represented by those tests and any concrete in the mixer chute shall be wasted, and the necessary adjustments shall be made in the mix design or proportioning devices.

505.10.4.6 When concrete density is specified, in-place density of plastic concrete will be determined in accordance with MoDOT Test Method TM 36. In-place density will be determined at a minimum passing test rate of one per 100 square yards or three per continuous pour, whichever is greater. A nuclear gauge correction factor will be determined at least once for each day of concrete production. Work bridges spanning the plastic concrete shall be provided by the contractor to permit performing nuclear density tests.

505.10.5 Mixing.

505.10.5.1 Concrete shall be mixed in accordance with Sec 501.

505.10.5.2 Mixing time for rotating paddle type mixers shall be a minimum of 60 seconds after all ingredients have been added. All batches shall be mixed approximately the same length of time. Material for a batch of concrete shall not be placed in the mixing drum until the material for the previous batch has been discharged.

505.10.6 Surface Preparation.

505.10.6.1 On new concrete decks, the surface shall be given a very rough texture while still plastic by use of a wire comb or other approved texturing device which will produce a bondable surface acceptable to the engineer.

505.10.6.2 On ~~old~~ existing concrete decks with existing wearing surfaces, the wearing surface shall be removed in accordance with Sec 216. On existing concrete decks without existing wearing surfaces, the surface shall be scarified in accordance with Sec 216.

505.10.6.3 For non-hydro demolition projects, ~~T~~the textured or scarified deck shall be sand or shot blasted followed by an air blast. The sand or shot blast shall remove all dirt, oil and other foreign material, as well as any unsound concrete or laitance from the surface and edges against which new concrete is to be placed. The compressor shall be equipped to prevent oil in the air supply. That portion of the curb and previously placed ~~overlay~~wearing surfaces against which new concrete is to be placed shall be sand or shot blasted. Any loose or foreign material detected on the concrete surface prior to placement of the ~~overlay~~wearing surface shall be removed by sand, shot or air blasting. ~~Containment~~Clean-up and disposal of blast material shall be in accordance with Sec 202.3.1.3~~2~~. The concrete surface may require retexturing where penetration of foreign material is evident. No contamination of the retextured or scarified concrete surface will be permitted.

505.10.6.4 For hydro demolition projects, total surface hydro demolition shall be performed in accordance with Sec 216 and the following additional surface preparation.

505.10.6.4.1 All areas of the deck, where further removal of concrete was performed with pneumatic hammering after the hydro demolition, shall be thoroughly sand or shot blasted to remove any loose material and micro-cracking. Clean-up and disposal of blast material shall be in accordance with Sec 202.3.1.3.

505.10.6.4.2 After completion of sand or shot blasting and associated clean-up of debris, the entire deck surface shall be thoroughly cleaned by a minimum 7000 psi pressure water blasting to remove all debris and slurry residue within 24 hours prior to wearing surface placement begins. Water blasting shall continue until the run-off water from cleaning flows clear.

505.10.6.4.3 After cleaning, the deck surface shall be thoroughly saturated to the point that the surface does not dry out, and any excess water removed with compressed air. Clean polyethylene sheeting shall then be used to cover the deck completely until such time as the wearing surface is placed. Just prior to placement of the wearing surface, the deck shall be brought to a saturated surface dry (SSD) condition and maintained in a SSD condition throughout the pour, with no ponding of water.

505.10.6.4.4 Any standing water on the deck or in the depressed areas of monolithic deck repair shall be removed prior to placement of wearing surface material.

505.10.6.5 To assure that the thickness of the concrete ~~overlay~~wearing surface above the prepared surface will be as specified on the plans, the clearance shall be checked in the following manner before concrete is placed. A filler block having a thickness 1/8 inch less than the ~~overlay~~wearing surface thickness shall be attached to the bottom of the screed. With screed guides in place, the screed shall be passed over the area to be concreted. Where the intended clearance does not allow use of this method, a stringline or other means shall be used, subject to approval from the engineer. All ~~old~~ existing concrete shall be removed that does not have sufficient clearance ~~shall be removed~~.

505.10.8.13 After texturing the concrete surface, but before applying the wet cure, all vertical joints with the adjacent concrete shall be sealed by painting with thinned grout consisting of equal parts cement, sand and sufficient water for the mixture to be the consistency of paint.

505.10.8.14 After the joint painting is completed, the freshly placed lane and joint shall be promptly covered with a single layer of clean, wet burlap. Care shall be exercised to ensure that the wet burlap is well drained and that the burlap is placed as soon as the surface will support the burlap without deformation.

505.10.8.15 The wet cure shall be applied within 30 minutes after the concrete has been placed on the deck, except when the surface will be excessively marred by doing so, as determined by the engineer. If the concrete requires refinishing because of failure to meet density requirements, the time will be extended 15 minutes. Failure to apply wet cure within the required time will be cause for rejecting the work affected. Surface concrete in the rejected area shall be removed and replaced by the contractor at the contractor's expense.

505.10.8.16 The surface shall receive a wet cure of at least 72 hours.

505.10.8.17 After placement and cure of the low slump concrete, the finished deck will be tested to detect unbonded areas.

505.10.8.18 As soon as curing has been completed, the riding surface will be thoroughly straightedged by the engineer and all variations exceeding 1/8 inch in 10 feet will be plainly marked. Areas more than 1/8 inch high shall be removed by an approved device consisting of multiple cutting edges leaving a grooved surface finish comparable to that produced by the texturing device. A bush hammer or other impact device shall not be used.

505.10.8.19 The surface of low slump concrete shall be sealed in accordance with Sec 703.3.8 and payment for furnishing and placing shall be included in the contract unit price for other items.

505.10.9 Supplementary Wearing Surface Material. This work shall consist of providing and placing additional wearing surface material in excess of the material required for the wearing surface at plan thickness.

505.10.9.1 Supplementary wearing surface material will be required when conditions require the actual wearing surface thickness to exceed plan thickness, including but not limited to:

(a) Thickness of existing wearing surface removed exceeds plan thickness.

(b) Correcting profile grade and cross section deficiencies of the existing deck.

(c) Contractor’s negligence in milling too deep during scarification or removal of existing wearing surface.

(d) Contractor’s negligence in cutting sound deck concrete too deep during hydro demolition including excessive overlap of hydro demolition passes.

505.10.9.2 Supplementary wearing surface material will be required to fill the depressions of monolithic deck repair in the deck below the bottom of the planned deck wearing surface thickness. This material is placed monolithic during the deck wearing surface process.

505.10.10~~.9~~ Limitations of Operations.

505.10.10.~~9~~.1 Vehicle traffic shall not be permitted on the low slump concrete surface for 72 hours and until 3,000 psi compressive strength is attained.

505.10.10.~~9~~.2 No low slump concrete shall be placed at ambient temperatures below 45 F or above 85 F. Concrete placement may begin when the air temperature and deck temperature is 45 F and rising. Concrete shall not be exposed to freezing temperatures until a strength of 3,000 psi has been attained. Any concrete damaged by freezing shall be removed and replaced at the contractor's expense.

505.10.10.~~9~~.3 When the weather forecast predicts temperatures of 85 F or higher, the contractor shall schedule placing and finishing low slump concrete during hours in which the ambient temperature will be lower than 85 F. The mixed concrete when placed shall have a maximum temperature of 90 F.

505.10.10.~~9~~.4 Concrete shall not be placed adjacent to a parallel surface course that is less than 72 hours old. This restriction will not apply to a continuation of placement in a lane or strip beyond a joint in the same lane or strip.

505.10.10.~~9~~.5 Preparation of the area may be started in a lane or strip adjacent to a newly placed surface the day following placement of the new surface. If this work is started before the end of the 72-hour curing period, the work shall be restricted as follows:

(a) Sawing or other operations shall interfere with the curing process for the minimum practical time only, in the immediate work area only, and the curing shall be resumed promptly.

(b) No power-driven tools heavier than 15 pounds shall be used.

(c) Air compressors shall be operated on the deck only directly over the piers.

(d) No loads other than construction equipment shall be permitted on any portion of the bridge floor that has undergone preparation prior to placement and curing of new concrete.

505.10.11.~~10~~ Removal. All material removed shall be disposed of by the contractor at the contractor's expense in a location meeting the approval of the engineer.

505.10.12.~~11~~ Repair.

505.10.12.~~11~~.1 Unbonded areas will be marked by the engineer. The contractor shall saw cut and remove the affected area. All saw cuts shall be straight vertical lines and form square corners at all changes in direction. After removal of the concrete, the surface of the area to be repaired and vertical saw cuts shall be cleaned of all loose or foreign material by sand or shot blasting and then air blasting. The surface shall be comparable to the original concrete surface prior to the original ~~overlay~~wearing surface being placed.

505.10.12.~~11~~.2 The concrete used for repair shall meet the same requirements as the original mixture. The concrete shall be vibrated with a surface or pan-type vibrator to obtain compaction. Spud type vibrators shall not penetrate to contact with the original concrete. Surface finish and curing shall be in accordance with the specifications for the mixture used.

505.10.13.~~12~~ Method of Measurement.

505.10.13.1 Final measurement of the wearing surface at plan thickness will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, t~~T~~he area of ~~concrete~~ wearing surface will be measured ~~and computed~~ to the nearest square yard~~. This area will be~~ based on measurement~~d~~ longitudinally from end to end of bridge deck and transversely between roadway face of curbs, excluding ~~from measurement~~ the area of any ~~drains and~~ expansion devices. The revision or correction will be computed and added to or deducted from the contract quantity.

505.10.13.2 Measurement of supplementary wearing surface material will be made to the nearest cubic yard by deducting the theoretical volume of material necessary to construct the wearing surface at plan thickness from the total volume of deck wearing surface material placed on the deck surface. Deductions will be made for:

(a) Material wasted.

(b) Material used to correct contractor's negligence in milling too deep during scarification or removal of existing wearing surface.

(c) Material used to fill contractor's negligence in cutting sound deck concrete too deep during hydro demolition including excessive overlap of hydro demolition passes.

505.10.14.~~13~~ Basis of Payment.

505.10.14.1 The accepted quantities of the wearing surface at plan thickness, complete in place, will be paid for at the contract unit price. ~~Payment for the above described work shall be considered completely covered by the contract unit price per square yard of concrete wearing surface.~~

505.10.14.2 The accepted quantities of supplementary wearing surface material, complete in place, will be paid for at the fixed contract unit price specified in Sec 109.15.

SECTION 505.20 LATEX MODIFIED CONCRETE.

505.20.1 Description. This work shall consist of constructing a ~~wearing surface of~~ latex modified concrete wearing surface on a prepared surface in accordance with ~~these~~ this specification~~s~~ as shown on the plans or as directed by the engineer.

505.20.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Type I or II Cement	1019
Latex Emulsion Admixture	1054
Polyethylene Sheeting	1058
Water	1070

505.20.2.1 Aggregate shall be in accordance with Sec 505.10.2.

505.20.2.2 Pozzolanic material or Portland pozzolan cements shall not be used.

505.20.2.3 Latex admixture shall be kept in a suitable enclosure that will protect the admixture from freezing and from exposure to temperatures in excess of 85 F. Drums of latex admixture

cleaned immediately prior to beginning proportioning and as often as necessary thereafter. Latex admixtures of different brands shall not be combined together in any manner.

505.20.6 Surface Preparation. Surface preparation shall be in accordance with Sec 505.10.6 except as specified herein.

505.20.6.1 Prior to scarifying or chipping on concrete adjacent to latex modified concrete, 96 hours of curing shall elapse. If practical, all scarifying by mechanical units shall be completed prior to placing any latex modified concrete, unless otherwise shown on the plans. Areas from which unsound concrete and patches have been removed shall be kept free of slurry produced by wet sawing or wet scarifying by planning the work such that this slurry will drain away from the completed areas of preparation.

505.20.6.2 On both ~~old~~existing and new decks for non-hydro demolition projects, within 24 hours prior to placing latex modified concrete, the entire surface shall be thoroughly cleaned by sand or shot blasting followed by an air blast. ~~Containment~~Clean-up and disposal of blast material shall be in accordance with Sec 202.3.1.3~~2~~.

505.20.7 Finishing Equipment.

505.20.7.1 The finishing machine shall be self-propelled and shall be capable of forward and reverse movement under positive control, with a provision for raising all screeds to clear the screeded surface for traveling in reverse. A self-propelled finishing machine with one or more rollers, augers and 1~~,~~500 to 2~~,~~500 vpm vibratory pans shall be used. A drag float may be necessary. Any modifications will be subject to approval from the engineer.

505.20.7.2 Support rails shall be in accordance with Sec 505.10.7.4.

505.20.8 Placing and Finishing Concrete. Placing and finishing shall be in accordance with Sec 505.10.8 except as specified herein.

505.20.8.1 Prior to placement of latex modified concrete, the cleaned surface shall be thoroughly wetted for a minimum of three hours, then covered with polyethylene sheeting until time of concrete placement. The surface shall be damp at the time the ~~overlay~~wearing surface is placed. Any standing water in depressions, holes or areas of concrete removal shall be blown out with compressed air. No free water or puddles of standing water shall exist at the time of placement.

505.20.8.2 Hand vibrators shall be used in areas of monolithic deck repair in the deck below the bottom of the planned deck wearing surface thickness where concrete is being placed around reinforcement, deeper areas within the pour, and along curb lines and construction joints. Deep areas shall be filled in advance during the wearing surface pour so that material stiffens enough that it will not roll back under the paving screed.

505.20.8.3~~.2~~ Expansion joints and dams shall be formed in the concrete ~~overlay~~wearing surface. Formation of the joint by sawing through the ~~overlay~~wearing surface will not be permitted.

505.20.8.4~~.3~~ Texturing shall occur immediately after finishing and before the plastic film forms on the surface. Texturing shall be performed in a manner to prevent pulling the concrete away from an existing vertical face. Care shall be taken not to texture too deep and not to tear the surface.

505.20.8.5~~.4~~ Screed rails and headers shall be separated from the newly placed material by passing a pointing trowel along the inside face. Metal expansion dams shall not be separated from the ~~overlayment~~ wearing surface. The trowel cut shall be made for the entire depth and

length of rails or headers after the mixture has stiffened sufficiently and shall prevent the concrete from flowing back into the cut.

505.20.8.6~~.5~~ During placement of the ~~overlay~~wearing surface, all joints with adjacent concrete shall be sealed with a mortar paste of equal parts cement and fine aggregate, using latex emulsion in lieu of mixing water.

505.20.8.7~~.6~~ The wet cure shall be applied promptly after the concrete has been placed on the deck without deforming the finished surface.

505.20.8.8~~.7~~ The surface shall receive a wet cure for at least 48 hours.

505.20.8.9~~.8~~ After placement and cure of the latex modified concrete, the finished deck will be tested to detect unbonded areas.

505.20.8.10~~.9~~ No surface sealing shall be applied to the latex modified concrete wearing surface.

505.20.9 Supplementary Wearing Surface Material. Supplementary wearing surface material shall be in accordance with Sec 505.10.9.

505.20.10~~.9~~ **Limitations of Operations.**

505.20.10~~.9~~**.1** No latex modified concrete shall be placed when the ambient or deck surface temperature is above 85 F. Deck temperature shall be determined in accordance with MoDOT Test Method TM 20.

505.20.10~~.9~~**.2** No latex modified concrete shall be placed at ambient or deck surface temperatures below 45 F. Latex modified concrete shall be protected to maintain a minimum specified curing temperature of 45 F. Any concrete damaged by freezing or that is exposed to a temperature of less than 45 during the first 8 hours after placement shall be removed and replaced at the contractor's expense.

505.20.10~~.9~~**.3** The temperature of the latex modified concrete at time of placement shall be between 45 F and 90 F. If either the aggregate or water is heated, the maximum temperature for each shall be 100 F at the time of addition to the mix. Any method of heating during the mixing of concrete may be used provided the heating apparatus will heat the mass uniformly and avoid hot spots that will burn the material. Cement or aggregate containing lumps or crusts of hardened material or frost shall not be used.

505.20.10~~.9~~**.4** No vehicular traffic shall be permitted on the latex modified concrete surface until the concrete is at least 72 hours old and has attained a minimum compressive strength of 3,000 psi.

505.20.10~~.9~~**.5** Concrete shall not be placed adjacent to a parallel surface course that is less than 96 hours old; however, this restriction will not apply to a continuation of placement in a lane or strip beyond a joint in the same lane or strip.

505.20.10~~.9~~**.6** Preparation of the area, except scarifying, may be started in a lane or strip adjacent to a newly placed surface the day following the surface placement. If this work is started before the end of the 48-hour wet curing period, the work will be restricted such that any interference with the curing process is held to the minimum practical time.

505.20.10~~.9~~**.7** Longitudinal construction joints shall be placed between designated traffic lanes. The location of the longitudinal joints will be subject to the approval from the engineer.

505.30.3 Concrete Mixture.

505.30.3.1 The contractor shall submit a mix design to Construction and Materials with the following properties:

Property	Requirement
Air Content, percent, min~~imum~~.	5.0
Slump, inches~~,~~	3.0 to~~–~~ 7.5 ~~1/2~~
Cement Content, ~~pounds~~lb/c~~ubic~~ y~~ard~~, min	640
Water/Cement Ratio, ~~-~~lb~~s.~~ water/lb~~s.~~ cement~~itous materials~~, max.~~, max.~~	0.37
Silica Fume, % replacement of cement	6.0 to ~~-~~8.0
~~Percent~~ Fine Aggregate, ~~(as percent~~% of total ~~fine and coarse~~ aggregate by absolute volume~~)~~	50 to~~–~~ 55
High Range Water Reducer	As required

505.30.3.2 The water content shall include all free moisture in the fine and coarse aggregate, water content of the silica fume admixture and water content of the high range water reducer.

505.30.3.3 The contractor shall designate in the mix design letter what target the slump will be in the field.

505.30.4 Testing. Testing will be done in accordance with Sec 505.10.4.

505.30.5 Mixing.

505.30.5.1 Silica fume concrete shall be batched and mixed in accordance with Sec 501, except as herein specified.

505.30.5.2 High range water-reducing admixtures shall be incorporated and mixed into the silica fume concrete in accordance with the silica fume admixture manufacturer's recommendations and as approved by the engineer. Water-reducing admixtures may be added by hand methods. The water-reducing admixture shall not be mixed with the air-entraining admixture nor shall the water reducer be added to the same portion of the mixing water as the air-entraining admixture. Either the air-entraining admixture or the water-reducing admixture shall be mixed into the concrete before the other is added.

505.30.5.3 Truck mixed silica fume concrete shall be initially mixed for at least 70 revolutions at a rate of no less than 12 revolutions per minute or more than 18 revolutions per minute. Truck mixed silica fume concrete shall be transported to the work site at agitating speeds of 2 to 6 revolutions per minute. After arriving at the work site and before use, the silica fume concrete shall be mixed for at least 30 revolutions at 12 to 18 revolutions per minute.

505.30.5.4 If on-site rotating paddle-type mixers or on-site rotating drum mixers are used, the length of mixing time and the revolution rate shall be as recommended by the silica fume admixture manufacturer.

505.30.5.5 The silica fume admixture manufacturer's technical representative shall advise the engineer in writing of the proper batching sequence, mixing time, mixing speed and other handling procedures necessary to produce a uniform, homogeneous mixture in accordance with this specification prior to preparation of silica fume concrete trial batches or placement of any silica fume concrete.

505.30.5.6 Prior to placement of concrete in the work, the contractor may be required to prepare trial batches of concrete for tests. Trial batches shall comply with and be paid for in accordance with Sec 501.

505.30.6 Surface Preparation. Surface preparation shall be in accordance with Sec 505.10.6.

505.30.7 Finishing Equipment. The finishing machine shall be designed for striking off and finishing silica fume concrete ~~overlay~~wearing surface. The finishing machine, screeds, traveling strike off and support rails shall be in accordance with Sec 505.10.7.

505.30.8 Placing and Finishing Concrete. Placing and finishing shall be in accordance with Sec 505.10.8 except as noted herein.

505.30.8.1 The cleaned areas to receive the ~~overlay~~wearing surface shall be thoroughly and continuously wetted with water at least three hours before placement of the ~~overlay~~wearing surface is started, then covered with polyethylene sheeting until the time of placement. Any accumulations of water shall be dispersed or removed prior to applying the ~~overlay~~wearing surface.

505.30.8.2 Hand vibrators shall be used in areas of monolithic deck repair in the deck below the bottom of the planned deck wearing surface thickness where concrete is being placed around reinforcement, deeper areas within the pour, and along curb lines and construction joints. Deep areas shall be filled in advance during the wearing surface pour so that material stiffens enough that it will not roll back under the paving screed.

505.30.8.3~~.2~~ Since silica fume concrete produces very little bleed water, the engineer may require one or both of the following procedures to maintain a surface film until the burlap is placed.

505.30.8.3~~.2~~.1 A commercially available evaporative retarder may be used judiciously with a misting device during the finishing process until the wet burlap is applied only to prevent the surface of the concrete from drying out. The evaporative retarder shall not be used to increase surface workability.

505.30.8.3~~.2~~.2 Fogging may be done to increase humidity in the area of placement. Any fogging shall be done with nozzles specifically designed for fogging, with a maximum rate of one gallon per minute per nozzle.

505.30.8.4~~.3~~ The surface shall receive a wet cure for at least 7 days. Time when the ambient temperature is below 45 F will not be counted as cure time. Cure shall be continued until 3~~,~~000 psi compressive strength has been attained.

505.30.8.5~~.4~~ The finished deck will be examined for cracking. If cracking is found, the engineer will determine whether cracking is detrimental, whether remedial surface repairs are needed or whether the ~~overlay~~wearing surface in the cracked area should be removed and replaced. All remedial surface repairs, removal or replacement shall be done by the contractor at the contractor's expense.

505.30.8.6~~.5~~ After placement and cure of the silica fume concrete, the finished deck will be tested to detect unbonded areas.

505.30.8.7~~.6~~ No surface sealing shall be applied to the silica fume concrete wearing surface.

505.30.9 Supplementary Wearing Surface Material. Supplementary wearing surface material shall be in accordance with Sec 505.10.9.

505.40.5.~~6~~.4 Each drum of latex admixture shall be mechanically agitated or hand rolled until thoroughly mixed prior to being introduced into the mixer storage compartment. Latex admixture that is stored in the mixer storage compartment overnight or during delays in mixing of four hours or more shall be agitated by at least two complete cycles in a continuous circulating pump or by mechanical means in the storage compartment. The flow through screen shall be cleaned immediately prior to beginning proportioning and as often as necessary thereafter. Latex admixtures of different brands shall not be combined together in any manner.

505.40.5.~~6~~.5 The water/cement ratio shall be within 0.02 of that specified in the approved mix design. If adjustments for water content beyond that are necessary, a previously tested and approved mixture shall be used.

505.40.5.~~6~~.6 Prior to placement of concrete in the work, the contractor shall be required to prepare trial batches of concrete for testing. Trial batches shall comply with the limits specified in this ~~provision~~specification.

505.40.6.~~7~~ Surface Preparation. Surface preparation shall be in accordance with Sec 505.10.6 except as specified herein.

505.40.6.~~7~~.1 Prior to scarifying or chipping on concrete adjacent to latex modified very early strength concrete, 24 hours of curing shall elapse. If practical, or unless otherwise shown on the plans, all scarifying by mechanical units shall be completed prior to placing any latex modified very early strength concrete. Areas from which unsound concrete and patches have been removed shall be kept free of slurry produced by wet sawing or wet scarifying by planning the work such that this slurry will drain away from the completed areas of preparation.

505.40.6.~~7~~.2 On both ~~old~~ existing and new decks for non-hydro demolition projects, within 24 hours before ~~latex modified very early strength concrete~~ placement of the wearing surface begins, the entire surface shall be thoroughly cleaned by hydro blasting followed by an air blast in accordance with Sec 505.10.6.4.2~~Sec 505.10~~.

505.40.6.~~7~~.3 ~~Containment~~Clean-up and disposal of blast material shall be in accordance with Sec 202.3.1.3~~2~~.

505.40.7.~~8.0~~ Finishing Equipment.

505.40.7.~~8~~.1 The finishing machine shall be in accordance with Sec 505.20.7. ~~self propelled with one or more rollers, augers and vibratory pans capable of 1,500 to 2,500 vpm. It shall also be capable of forward and reverse movement under positive control, with a provision for raising all screeds to clear the screeded surface for traveling in reverse. A drag float may be necessary. Any modifications shall be subject to approval from the engineer.~~

505.40.7.~~8~~.2 Support rails shall be in accordance with Sec 505.10.7.

505.40.8.~~9~~ Placing and Finishing Concrete. Placing and finishing shall be in accordance with Sec 505.10.8 except as specified herein.

505.40.8.~~9~~.1 Prior to placement of latex modified very early strength concrete, the cleaned surface shall be thoroughly wetted for a minimum of one hour, then covered with polyethylene sheeting until time of concrete placement. The surface shall be damp at the time the ~~overlay~~wearing surface is placed. Any standing water in depressions, holes or areas of concrete removal shall be blown out with compressed air. No free water or puddles of standing water shall exist at the time of placement.

505.40.8.2 Hand vibrators shall be used in areas of monolithic deck repair in the deck below the bottom of the planned deck wearing surface thickness where concrete is being placed around reinforcement, deeper areas within the pour, and along curb lines and construction joints. Deep areas shall be filled in advance during the wearing surface pour so that material stiffens enough that it will not roll back under the paving screed.

505.40.8.3~~.9.2~~ Expansion joints and dams shall be formed in the concrete ~~overlay~~wearing surface. Formation of the joint by sawing through the ~~overlay~~wearing surface will not be allowed.

505.40.8.4~~.9.3~~ Water shall not be added to the surface of the concrete during finishing. A commercially available evaporation retardant may be used judiciously with a misting device during the finishing process until the wet burlap is applied only to prevent the surface of the concrete from drying out. The evaporation retardant shall not be used to increase surface workability.

505.40.8.5~~.9.4~~ Texturing shall occur immediately after finishing and before the plastic film forms on the surface. Texturing shall be performed in a manner to prevent pulling the concrete away from an existing vertical faceCare shall be taken not to texture too deep and not to tear the surface.

505.40.8.6~~.9.5~~ Screed rails and headers shall be separated from the newly placed material by passing a pointing trowel along their inside face. Metal expansion dams shall not be separated from the new ~~overlay~~wearing surface. The trowel cut shall be made for the entire depth and length of rails or headers after the mixture has stiffened sufficiently and shall prevent the concrete from flowing back into the cut.

505.40.8.7~~.9.6~~ During placement of the ~~overlay~~wearing surface, all joints with adjacent concrete shall be sealed with a mortar paste of equal parts cement and fine aggregate, using latex emulsion in lieu of mixing water.

505.40.8.8~~.9.7~~ The ~~overlay~~wearing surface concrete shall be moist cured from the time placed until opened to traffic.

505.40.8.9~~.9.8~~ The wet cure shall be applied promptly after the concrete has been placed on the deck without deforming the finished surface.

505.40.8.10~~.9.9~~ Within one hour of covering with wet burlap, a layer of white polyethylene sheeting shall be placed on the wet burlap. The surface shall receive a wet cure until the latex modified very early strength concrete has attained a compressive strength of at least 3~~,~~200 psi.

505.40.8.11~~.9.10~~ The thickness of the ~~overlay~~wearing surface shall not exceed 3 inches, unless otherwise approved by the engineer.

505.40.8.12~~.9.11~~ The finished deck will be examined for cracking. If cracking is found, the engineer will determine whether cracking is detrimental, whether remedial surface repairs are needed or whether the ~~overlay~~wearing surface in the cracked area should be removed and replaced. All remedial surface repairs, removal or replacement shall be done by the contractor at the contractor's expense.

505.40.8.13~~.9.12~~ After placement and curing of the latex modified very early strength concrete, the finished deck will be tested to detect unbonded areas.

505.40.8.14~~.9.13~~ No surface sealing shall be applied to the latex modified very early strength concrete wearing surface.

505.40.9 Supplementary Wearing Surface Material. Supplementary wearing surface material shall be in accordance with Sec 505.10.9.

505.40.10 Limitations of Operations.

505.40.10.1 No latex modified very early strength concrete shall be placed when the ambient or deck surface temperature is above 85 F. Deck temperature shall be determined in accordance with MoDOT Test Method T20.

505.40.10.2 Since latex modified very early strength concrete may not exhibit bleed water, the probability of plastic shrinkage cracking is increased. At surface evaporation rates above 0.1 pounds per square foot per hour plastic shrinkage cracking is probable and the contractor should take precautions such as erecting windbreaks, lowering the mix temperature or delaying operations until ambient temperatures are lower. Fogging the concrete surface will only be allowed, as provided for in this specification. Surface evaporation rates can be predicted from mix temperature, air temperature, relative humidity and wind velocity using Figure 1 of ACI 308-81 (revised 1986) "Standard Practice for Curing Concrete".

505.40.10.3 A fogging system shall be in-place prior to concrete placement. The fogging system shall consist of pressurized equipment that distributes water at minimum rate of 0.10 gallon per hour per square foot. The fogging system shall apply the fog uniformly over the entire surface of the bridge deck. The fogging system shall produce atomized water that has a droplet with a maximum diameter of 0.003 inch~~es~~ and which keeps the finished deck surface saturated without producing standing water. The contractor shall submit a letter certifying that their fogging system is in accordance with this ~~provision~~specification.

505.40.10.4 The fogging system shall be started progressively along the length of the deck, during or immediately after floating.

505.40.10.5 No latex modified very early strength concrete shall be placed at ambient or deck surface temperatures below 45 F. Latex modified very early strength concrete shall be protected to maintain a minimum specified curing temperature of 45 F. The contractor shall provide a method, meeting the approval of the engineer, of monitoring the concrete that demonstrates that the concrete has been maintained above the minimum curing temperature and has been protected from freezing. Any concrete damaged by freezing or which is exposed to a temperature of less than 45 F during the first 8 hours after placement shall be removed and replaced at the contractor's expense.

505.40.10.6 The temperature of the latex modified very early strength concrete at time of placement shall be between 45 F and 90 F. If either the aggregate or water is heated, the maximum temperature for each shall be 100 F at the time of addition to the mix. Any method of heating during the mixing of concrete may be used provided the heating apparatus will heat the mass uniformly and avoid hot spots which will burn the material. Cement or aggregate containing lumps or crusts of hardened material or frost shall not be used.

505.40.10.7 No vehicle traffic shall be permitted on the latex modified very early strength concrete surface until the latex modified very early strength concrete has attained a minimum compressive strength of 3~~,~~200 psi. Compressive strength will be determined by tests conducted in accordance with MoDOT test methods.

505.40.10.8 Concrete shall not be placed adjacent to a parallel surface course which is less than 24 hours old; however, this restriction will not apply to a continuation of placement in a lane or strip beyond a joint in the same lane or strip.

505.40.10.9 Preparation of the area, except scarifying, may be started in a lane or strip adjacent to newly placed surface the day following the surface placement. If this work is started before the end of the curing period, the work will be restricted such that any interference with the curing process is held to the minimum practical time only.

505.40.10.10 Longitudinal construction joints shall be placed between designated traffic lanes. The location of the longitudinal joints shall be subject to the approval from the engineer.

505.40.10.11 Transverse joints in the ~~overlay~~wearing surface may be permitted if approval by the engineer. Transverse joints shall be located a minimum of 10 feet from the centerline of bent.

505.40.10.12 A header shall be installed in case of delay in the placement operations exceeding one-half hour in duration. During minor delays of one-half hour or less, the end of the placement shall be protected from drying with several layers of wet burlap.

505.40.10.13 Adequate precautions shall be taken to protect freshly placed concrete from rain. All placing operations shall stop when rain begins. The engineer may order removal of any material damaged by rainfall and such material shall be replaced in accordance with this specification at the contractor's expense.

505.40.11 Removal. ~~Material r~~Removal ~~and disposal~~ shall be in accordance with Sec 505.11~~.10~~.

505.40.12 Repair. Repair shall be in accordance with Sec 505.10.12.

505.40.13 Method of Measurement. Measurement will be in accordance with Sec 505.10.13.

505.40.14 Basis of Payment. ~~The basis for p~~Payment will be in accordance with Sec 505.10.14.

SECTION 505.50 CSA CEMENT VERY EARLY STRENGTH CONCRETE.

505.50.1 Description. This work shall consist of constructing a calcium sulfoaluminate dicalcium silicate (CSA) cement very early strength concrete wearing surface on a prepared surface in accordance with this specification, as shown on the plans or as directed by the engineer.

505.50.2 Material. All material shall be in accordance with Division 1000, Materials Details and specifically as follows:

Item	Section
Water Reducing Admixture	1054
Burlap	1055
Polyethylene Sheeting	1058
Water	1070

505.50.2.1 CSA cement shall be a Type VRH (very rapid hardening) in accordance with ASTM C 1600. Mixing other hydraulic cements with CSA cement will not be permitted.

505.50.2.2 Coarse aggregate shall be an approved crushed limestone, crushed quartzite, flint chat from the Joplin area, or porphyry in accordance with Sec 1005, Gradation E, except the percentage of deleterious substances shall not exceed the following values, and the sum of percentages of all the deleterious substances shall not exceed one percent.

Item	Percent by Weight
Deleterious Rock	1.0
Shale and Pyrite	0.2
Chert in Limestone	0.5
Other Foreign Material	0.1

505.50.2.3 Fine aggregate shall be in accordance with Sec 1005 and shall be Class A sand in accordance with Sec 501.

505.50.2.4 With approval of the engineer, other gradations of coarse or fine aggregate may be used, however all quality requirements, including a maximum of 2 percent passing the No. 200 for fine and coarse aggregate, shall apply and the maximum aggregate size shall not exceed that of Sec 1005, Grade E aggregate.

505.50.2.5 Pozzoloanic material or Portland pozzolan cements shall not be used.

505.50.2.6 Type S admixtures in accordance with ASTM C 494 may be used, if approved by the engineer.

505.50.3 Concrete Mixture.

505.50.3.1 The concrete mixture shall meet the following requirements:

Property	Requirement
Air Content, percent	0.0 to 6.5
Water-Cement Ratio, lb water/lb cement	0.42 to 0.45
Slump (at discharge), inches	7.0 to 9.0
Slump (after discharge) [a], inches	3.0 to 6.0
Fine Aggregate, % of total aggregate by weight	50 to 55
Cement Content, lb/cy, min.	575

[a] Conduct test 7 to 10 minutes after discharge.

505.50.3.2 Chloride permeability shall not be greater than 1000 coulombs when tested in accordance with AASHTO T 277. Tests shall be performed on specimens at 28 days. This test shall be performed on each mixture submitted for approval. Tests shall be performed by a qualified commercial laboratory.

505.50.3.3 The mixture shall be designed to develop a minimum 3-hour compressive strength of 3000 psi and a minimum 28-day compressive strength of 4500 psi.

505.50.3.4 Air-entraining admixtures shall not be added.

505.50.3.5 A set control (citric acid) in accordance with the cement manufacturer's recommendations may be used.

505.50.3.6 Admixtures containing calcium chloride shall not be used.

505.50.3.7 Mix Design. The contractor shall submit the mix design to Construction and Materials for approval. The mix design shall be within the limits specified in this specification. The mix design shall also include actual results for the following information:

(a) Air.

(b) Slump.

(c) Compressive strengths at 3 hours, 6 hours, 12 hours, 24 hours, 7 days and 28 days. Compressive strengths shall be determined using three 4 by 8-inch cylinders or two 6 by 12-inch cylinders.

(d) Results of chloride permeability testing.

505.50.3.7.1 If other aggregate gradations than standard specifications are utilized, the contractor shall designate the intended target gradation and allowable gradation range for each fraction. The target gradations and allowable gradation ranges will be used for inspection and quality control of the aggregates.

505.50.3.7.2 Any change in mix design or proportions shall be approved by the engineer.

505.50.4 Testing. Testing will be done in accordance with Sec 505.10.4, except that the slump test will also be conducted 7 to 10 minutes after discharge from mixer. During the waiting period, concrete shall be deposited on the deck to allow for continued operations. Required adjustments to water shall be made upon notice of results of slump test.

505.50.5 Mixing.

505.50.5.1 The concrete shall be volumetrically mixed at the bridge site by a continuous mixer in accordance with Sec 501.

505.50.5.2 The concrete discharge from the mixer shall be uniform in composition and consistency. Mixing capability shall be such that initial and final finishing operations can proceed at a steady pace. Final finishing shall be completed before the formation of a plastic surface film on the surface.

505.50.5.3 The moisture content of aggregates at the time of proportioning shall be such that water will not drain or drip from a sample. Coarse and fine aggregate shall be furnished and handled to avoid variations in the moisture content affecting consistency of the concrete.

505.50.5.4 Adjustments to the water-cement ratio shall be in accordance with Sec 505.50.3.1. If adjustments for water content beyond that are necessary, a previously tested and approved mixture shall be used.

505.50.5.5 Prior to placement of concrete in the work, the contractor shall be required to prepare trial batches of concrete for testing. Trial batches shall comply with the limits specified in this specification.

505.50.6 Surface Preparation. Surface preparation shall be in accordance with Sec 505.10.6 except as specified herein.

505.50.6.1 Scarifying or chipping shall not be started until 6 hours of curing of adjacent parallel courses of the new wearing surface. Saw cutting of or adjacent to parallel courses of the new wearing surface shall not be started until 3 hours of curing of new wearing surface. If practical, or unless otherwise shown on the plans, all scarifying by mechanical units shall be completed prior to placing any wearing surface. Areas from which unsound concrete and patches have been removed shall be kept free of slurry produced by wet sawing or wet scarifying by planning the work such that slurry will drain away from the completed areas of preparation.

505.50.6.2 On both existing and new decks for non-hydro demolition projects, within 24 hours before placement of the wearing surface begins, the entire surface shall be thoroughly cleaned by hydro blasting followed by an air blast in accordance with Sec 505.10.6.4.2.

505.50.7 Equipment.

505.50.7.1 The finishing machine shall be in accordance with Sec 505.20.7 except the allowance for the use of truss or roller type screeds for narrow and short placements are subject to the approval of the engineer.

505.50.7.2 Support rails shall be in accordance with Sec 505.10.7.

505.50.8 Placing and Finishing Concrete. Placing and finishing shall be in accordance with Sec 505.10.8 except as specified herein.

505.50.8.1 Prior to placement of wearing surface, the cleaned surface shall be thoroughly wetted for a minimum of one hour, then covered with polyethylene sheeting until time of placement. All surfaces that will be covered with the wearing surface shall be damp at time of placement. Any standing water in depressions, holes or areas of concrete removal shall be blown out with compressed air or other type blowers sufficient for removal or removed with the use of vacuums. No free water or puddles of standing water shall exist at time of placement.

505.50.8.2 Hand vibrators shall be used in areas of monolithic deck repair in the deck below the bottom of the planned deck wearing surface thickness where concrete is being placed around reinforcement, deeper areas within the pour, and along curb lines and construction joints. Deep areas shall be filled in advance during the wearing surface pour so that material stiffens enough that it will not roll back under the paving screed.

505.50.8.3 Expansion joints and dams shall be formed in the wearing surface. Formation of the joint by sawing through the wearing surface will not be allowed.

505.50.8.4 Water shall not be added to the surface of the wearing surface during finishing. A commercially available evaporation retardant may be used judiciously with a misting device during the finishing process until the wet burlap is applied only to prevent the surface of the concrete from drying out. The evaporation retardant shall not be used to increase the surface workability.

505.50.8.5 Texturing shall occur immediately after finishing and before the plastic film forms on the surface. Texturing shall be performed in a manner to prevent pulling the concrete away from an existing vertical surface. Care shall be taken not to texture too deep and not to tear the surface.

505.50.8.6 Screed rails and headers shall be separated from the newly placed material by passing a pointing trowel along their inside face. Metal expansion dams shall not be separated from the new wearing surface. The trowel cut shall be made for the entire depth and length of the rails or headers after the mixture has stiffened sufficiently and shall prevent the concrete from flowing back into the cut.

505.50.8.7 During placement of the wearing surface, all joints with adjacent concrete shall be sealed with a mortar paste of equal parts cement and fine aggregate, using the CSA cement and water.

505.50.8.8 The wearing surface shall be wet cured from the time of placement a minimum of 3 hours and until a compressive strength of 3200 psi is achieved.

505.50.8.9 Wet burlap shall be applied promptly after the wearing surface has been placed on the deck without deforming the finish surface.

505.50.8.10 Within one hour of covering with burlap, a layer of white polyethylene sheeting shall be placed on the wet burlap. The wearing surface material shall be wet at all times during curing process and may require additional wetting by contractor.

505.50.8.11 The thickness of the wearing surface shall not exceed 3 inches, unless otherwise approved by the engineer.

505.50.8.12 The finished deck will be examined for cracking. If cracking is found, the engineer will determine whether cracking is detrimental, whether remedial surface repairs are needed or whether the wearing surface in the cracked areas should be removed and replaced. All remedial surface repairs, removal or replacement shall be done by the contractor at the contractor's expense.

505.50.8.13 After placement and curing of the wearing surface, the finished deck shall be tested to detect unbonded areas.

505.50.8.14 No surface sealing shall be applied to the wearing surface.

505.50.9 Supplementary Wearing Surface Material. Supplementary wearing surface material shall be in accordance with Sec 505.10.9.

505.50.10 Limitations of Operations.

505.50.10.1 No wearing surface shall be placed when ambient or deck surface temperature is above 85 F. Deck temperature shall be determined in accordance with MoDOT Test Method T20.

505.50.10.2 Since CSA cement very early strength concrete will not exhibit bleed water, the probability of plastic shrinkage surface cracking is increased. At surface evaporation rates above 0.1 pounds per square foot per hour plastic shrinkage is probable and the contractor shall take precautions such as erecting windbreaks, lowering the mix temperature, fogging or delaying operations until ambient temperatures and/or wind conditions are more favorable. Fogging the plastic concrete surface will only be allowed, as provided in this specification. Surface evaporation rates can be predicted from mix temperature, ambient temperature, relative humidity and wind velocity using Figure 1 of ACI 308-81 (revised 1986) "Standard Practice for Curing Concrete".

505.50.10.3 A fogging system shall be in-place prior to concrete placement. The fogging system shall consist of pressurized equipment that distributes water at a minimum rate of 0.10 gallons per hours per square foot. The fogging system shall apply the fog uniformly over the entire surface of the bridge deck. The fogging system shall produce atomized water that is a droplet with a maximum diameter of 0.003 inches and which keeps the finish deck surface saturated without producing standing water. The fogging system shall be started progressively along the length of the deck, during or immediately after floating. The contractor shall submit a letter certifying that their fogging system is in accordance with this specification.

505.50.10.4 No wearing surface shall be placed at ambient or deck temperatures below 45 F. Concrete shall be protected to maintain a minimum specified curing temperature of 45 F. The contractor shall provide a method, meeting the approval of the engineer, of monitoring the concrete that demonstrates that the concrete has been maintained above the minimum curing temperature and has been protected from freezing. Any concrete damaged by freezing or

which is exposed to a temperature of less than 45 F during the first 8 hours after placement shall be removed at the contractors expense.

505.50.10.5 The temperature of the concrete at time of placement shall be between 45 F and 90 F. If either the aggregate or water is heated, the maximum temperature for each shall be 100 F at time of addition to the mix. Any method of heating during the mixing of concrete may be used provided the heating apparatus will heat the mass uniformly and avoid hot spots which will burn the material. Cement or aggregate containing lumps or crusts of hardened material or frost shall not be used.

505.50.10.6 No vehicle traffic shall be permitted on the wearing surface until the concrete has attained a minimum compressive strength of 3200 psi. Compressive strength will be determined by tests conducted in accordance with MoDOT test methods.

505.50.10.7 Concrete shall not be placed adjacent to a parallel course which is less than 24 hours old; however, this restriction will not apply to a continuation of placement in the lane or strip beyond a joint in the same lane or strip.

505.50.10.8 Preparation of an area, except scarifying, may be started in the lane or strip adjacent to newly placed surface after 3 hours of wet curing. If this work is started before the end of the curing period, the work will be restricted such that any interference with the curing process is held to the minimum practical time only.

505.50.10.9 Longitudinal construction joints shall be placed between designated traffic lanes. The location of the longitudinal joints shall be subject to the approval of the engineer.

505.50.10.10 Transverse joints in the wearing surface may be permitted if approved by the engineer. Transverse joints shall be located a minimum of 10 feet from the centerline of bent.

505.50.10.11 A header shall be installed in case of delay in the placement operations exceeding one-half hour in duration. During minor delays of one-half hour or less, the end of the placement shall be protected from drying with several layers of wet burlap.

505.50.10.12 Adequate precautions shall be taken to protect the placement from rain. All placing operations shall stop when rain begins. The engineer may order removal of any material damaged by rainfall and such material shall be replaced in accordance with this specification at the contractor's expense.

505.50.11 Removal. Material removal and disposal shall be in accordance with Sec 505.10.11.

505.50.12 Repair. Repair shall be in accordance with Sec 505.10.12.

505.50.13 Method of Measurement. Measurement will be in accordance with Sec 505.10.13.

505.50.14 Basis of Payment. The basis of payment will be in accordance with Sec 505.10.14.

SECTION 505.60 STEEL FIBER REINFORCED CONCRETE.

505.60.1 Description. This work shall consist of constructing a steel fiber reinforced concrete wearing surface on a prepared surface in accordance with this specification, as shown on the plans or as directed by the engineer.

505.60.2 Material.

505.60.2.1 Concrete shall be Class B-1 or B-2 as specified on the plans and in accordance with Sec 501

505.60.2.2 Aggregate shall be in accordance with Sec 505.10.2.

505.60.2.3 Steel fibers shall be made from stainless steel and nominally be 2 inches long and meet the physical property requirements prescribed in ASTM A820. One-inch Helix fibers are also allowed. Steel fibers shall have a quantity of at least 2000 fibers per pound and a fiber aspect ratio of 40 to 60. The steel fibers shall not have any hooks or 90-degree bends. The steel fibers shall be free from rust, oil and other deleterious materials. Steel fibers shall be transported, stored and applied to the concrete mixture in accordance with the manufacturer's recommendations.

505.60.2.3.1 The contractor shall provide initial on-site technical assistance from the supplier of the steel fiber reinforcement. Further technical assistance shall be available at the request of the engineer.

505.60.3 Concrete Mixture. The contractor shall prepare and submit the mix design and mixing procedures to Construction and Materials for approval. The contractor shall not begin ordering materials mix design and mixing procedures are approved.

505.60.3.1 The contractor shall designate in the mix design letter what target the slump will be in the field.

505.60.3.2 The steel fiber dosage rate shall be 80 pounds per cubic yard of concrete.

505.60.3.3 Any change in mix design or proportions shall be approved by the engineer.

505.60.4 Testing. Testing shall be in accordance with Sec 505.10.4

505.60.5 Mixing. Mixing shall be in accordance with Sec 501.

505.60.6 Surface Preparation. Surface preparation shall be in accordance with Sec 505.10.6.

505.60.7 Finishing Equipment. The finishing machine shall be designed for striking off and finishing steel fiber reinforced concrete wearing surface. The finishing machine, screeds, traveling strike off and support rails shall be in accordance with Sec 505.10.7.

505.60.8 Placing and Finishing Concrete. Placing and finishing shall be in accordance with Sec 505.10.8 except as noted herein.

505.60.8.1 Pumping shall generally be in accordance with Sec 703. Unless otherwise approved by the engineer, the following practices shall be observed:

(a) Avoid rapid reduction in line size from the pump to the lines.

(b) Operating pressure inside the line should be kept as low as functionally possible.

(c) Use 5-inch (minimum) diameter clean, steel lines.

505.60.8.2 Placement Plan. At least six weeks prior to the first placement of the steel fiber reinforced concrete wearing surface on the project, a pre-placement conference shall be held with the contractor, the steel fiber supplier, the engineer and other parties involved with the steel fiber reinforced concrete wearing surface on the project. The contractor shall present the

plan for furnishing, placing, sampling and testing of the steel fiber reinforced concrete wearing surface in accordance with the requirements of this specification.

505.60.8.2.1 As part of the pre-placement conference a trial placement of steel fiber reinforced concrete wearing surface shall be made. The trial placement shall use the same delivery and placing equipment as shall be used in the actual work and shall use the mix design as approved by the engineer. For pumped concrete, simulate as closely as possible the distance and height that the concrete is to be pumped. As a minimum, the trial placement shall be a 10-foot by 10-foot by 4-inch thick slab.

505.60.8.2.2 Placement of steel fiber reinforced concrete wearing surface for the project shall not be allowed until the engineer approves the contractor's plan, including the results of the trial placements. Mixing, pumping, placing and finishing techniques should ensure uniform fiber distribution throughout the mixture without fiber balling or segregation. After approval, the placement plan shall not be changed unless approved in writing by the engineer.

505.60.8.2.3 The trial slab shall become the property of the contractor after the placement plan has been approved by the engineer and shall be removed and disposed of in accordance with Sec 202.

505.60.8.2.4 The curing and sealing of the concrete wearing surface on existing bridge decks shall be in accordance with Sec 703.3.6.

505.60.8.2.5 The curing of the concrete wearing surface on the bottom slab of existing box culverts shall be in accordance with Sec 703.3.6. Concrete sealer will not be required.

505.60.9 Supplementary Wearing Surface Material. Supplementary wearing surface material shall be in accordance with Sec 505.10.9.

505.60.10 Limitations of Operations. Operations shall be limited in accordance with Sec 505.10.10.

505.60.11 Removal. Material removal and disposal shall be in accordance with Sec 505.10.11.

505.60.12 Repair. Repair shall be in accordance with Sec 505.10.12.

505.60.13 Measurement of Payment. Measurement will be in accordance with Sec 505.10.13.

505.60.14 Basis of Payment. The basis of payment will be in accordance with Sec 505.10.14.

SECTION 505.70 POLYESTER POLYMER CONCRETE.

505.70.1 Description. This work shall consist of constructing a polyester polymer concrete wearing surface on a prepared surface in accordance with this specification, as shown on the plans or as directed by the engineer. Polyester polymer concrete wearing surface shall be composed of the following components – polyester resin binder, high molecular weight methacrylate (HMWM) resin and aggregate.

505.70.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Polyester Polymer Wearing Surface	1039

505.70.2.1 Delivery of Material. All material shall be delivered in their original containers bearing the manufacturer's label, specifying date of manufacturing, batch number, trade name, and quantity. Each shipment of polyester resin binder and HMWM resin shall be accompanied by a MSDS.

505.70.2.2 Storage of Material. The material shall be stored to prevent damage by the elements and to ensure the preservation of their quality and fitness for the work. The storage space shall be kept clean and dry, and shall contain a high-low thermometer. The temperatures of the storage space shall not fall below nor rise above that recommended by the manufacturer. Every precaution shall be taken to avoid contact with flame.

505.70.2.3 Inspection. Stored materials shall be inspected prior to their use, and shall meet the requirements of this Specification at the time of use.

505.70.2.4 Failure. Any material which is rejected because of failure to meet the required tests or that has been damaged so as to cause rejection shall be immediately replaced at no additional expense to the Commission.

505.70.2.5 Required Amount. Sufficient material to perform the entire polyester concrete application shall be in storage at the site prior to any field application, so that there shall be no delay in procuring the material for each day's application.

505.70.2.6 Training. The contractor shall arrange to have the material supplier furnish technical service related to application of material and health and safety training for personnel who are to handle the polyester polymer concrete and the HMWM resin prime coat.

505.70.2.7 Technical Support. The materials supplier shall have a representative onsite during placement of the polyester polymer concrete.

505.70.3 Concrete Mixture. The contractor shall prepare and submit the mix design and mixing procedures to Construction and Materials for approval. The contractor shall not begin ordering materials mix design and mixing procedures are approved.

505.70.3.1 The contractor shall designate in the mix design letter what target the slump will be in the field.

505.70.3.2 The mix design shall include a recommended initiator percentage for the expected application temperature.

505.70.3.3 Any change in mix design or proportions shall be approved by the engineer.

505.70.4 Testing. Testing shall be in accordance with Sec 505.10.4 except as specified herein.

505.70.4.1 Bond testing shall be performed for each placement on each day. Testing will be conducted at three locations 48 hours after placement. Testing will be performed in accordance to ACI 506R. A passing test is the failure of the concrete substrate or bond strength above 250 psi.

505.70.5 Mixing. Mixing shall be in accordance with Sec 501.

505.70.6 Surface Preparation. Surface preparation shall be in accordance with Sec 505.10.6 except as specified herein.

505.70.6.1 With approval from the engineer, the contractor may use automatic shot blasting units in lieu of sand blasting. The automatic shot blasting units shall be self-propelled and include a vacuum to recover spent abrasive. The abrasive shall be steel shot. Magnetic rollers shall be used to remove any spent shot remaining on the deck after vacuuming. Cleaned surfaces shall not be exposed to vehicular or pedestrian traffic other than that required by the wearing surface operation.

505.70.6.2 All steel surfaces that will be in contact with the wearing surface shall be cleaned in accordance with SSPC-SP10, Near –White Blast Cleaning, except that wet blasting methods shall not be allowed..

505.70.7 Finishing Equipment. The finishing machine shall be designed for striking off and finishing polyester polymer concrete wearing surface. The finishing machine, screeds, traveling strike off and support rails shall be in accordance with Sec 505.10.7.

505.70.8 Placing and Finishing Concrete. Placing and finishing shall be in accordance with Sec 505.10.8 except as noted herein.

505.70.8.1 Prime Coat. One coat of HMWM prime coat shall be applied to the prepared concrete and steel surfaces immediately before placing the polyester polymer concrete. The prime coat shall be uniformly applied to completely cover the surface to receive the wearing surface. The area receiving the prime coat shall be dry and had no exposure to any moisture within the past 24 hours. Prior to applying the prime coat, the surface shall be cleaned with compressed air to remove accumulated dust and any other loose material.

505.70.8.1.1 The concrete bridge deck surface shall be between 50 F and 100 F when applying the prime coat.

505.70.8.1.2 If the primed surface becomes contaminated, the contaminated area shall be cleaned by abrasive blasting and re-primed at no additional expense to the department.

505.70.8.2 Polyester Polymer Concrete. Polyester polymer concrete shall be placed immediately after the prime coat is applied to the bridge deck and within two hours of placing the prime coat.

505.70.8.2.1 Polyester polymer concrete shall not be placed when the relative humidity is above 90 percent.

505.70.8.2.2 The surface temperature of the area to receive polyester polymer concrete shall be the same as specified in Sec 505.70.8.1.1.

505.70.8.2.3 Mixing. The concrete shall be volumetrically mixed at the bridge site by a continuous mixer in accordance with Sec 501.

505.70.8.2.3.1 The continuous mixer shall be equipped with a metering device that automatically measures and records the aggregate volumes and corresponding resin volumes. The volumes shall be recorded at no greater than five-minute intervals along with the time and date of each recording. A printout of the recordings shall be furnished to the engineer at the end of each shift. Readout gages shall be visible to the Engineer at all times.

505.70.8.2.3.2 The concrete discharged from the mixer shall be uniform in composition and consistency. Mixing capability shall be such that initial and final finishing operations can proceed at a steady pace.

505.70.8.2.3.3 The Contractor shall prevent any cleaning chemicals from reaching the polyester polymer concrete mix during the mixing operation

505.70.8.2.3.4 Polyester polymer concrete shall be placed prior to gelling and within 15 minutes following the addition of initiator, whichever occurs first. Polyester polymer concrete that is not placed within this time shall be discarded.

505.70.8.2.3.5 The polyester resin binder in the polyester polymer concrete shall be 12 percent ± one percent by weight of the dry aggregate. The contractor shall determine the exact percentage as approved by the engineer.

505.70.8.2.3.6 The amount of peroxide initiator used shall result in a polyester polymer concrete set time between 30 and 120 minutes during placement. The initial set time will be determined by using an initial-setting time Gillmore needle in accordance with ASTM C266. Accelerators or inhibitors may be required as recommended by the polyester resin supplier and as approved by the engineer.

505.70.8.2.4 Finishing equipment shall be capable of consolidating the polyester polymer concrete and striking off the polyester polymer concrete to the final grade, thickness and cross-sections as shown in the contract documents.

505.70.8.3 Surface Texturing. The roadway surface, except within 12 inches of the inside face of the curb, shall be textured as soon as the condition of the polyester polymer concrete will permit. The roadway finishing shall otherwise be in accordance with Sec 502. Hand-operated devices producing a satisfactory texture will be permitted. At the contractor's option, a finned float with a single row of fins may be used. The grooves produced by the finned float shall be approximately 1/8 inch wide at 5/8 to 3/4-inch centers and shall be approximately 1/8 inch deep. This operation shall be performed at such a time and in such a manner that the desired texture will be achieved while minimizing displacement of the layer aggregate particles.

505.70.9 Supplementary Wearing Surface Material. Supplementary wearing surface material shall be in accordance with Sec 505.10.9.

505.70.10 Limitations of Operations. Operations shall be limited in accordance with Sec 505.10.10 except that traffic and construction equipment shall not be permitted on the polyester polymer concrete wearing surface for at least two hours and until the polyester polymer wearing surface has reached a minimum compressive strength of 3000 psi as verified by the rebound number determined in accordance with ASTM C805.

505.70.11 Removal. Material removal and disposal shall be in accordance with Sec 505.10.11.

505.70.12 Repair. Repair shall be in accordance with Sec 505.10.12.

505.70.13 Method of Measurement. Measurement will be in accordance with Sec 505.10.13.

505.70.14 Basis of Payment. The basis of payment will be in accordance with Sec 505.10.14.

SECTION 623

POLYMER PRODUCTS
~~CONCRETE BONDING COMPOUND, EPOXY MORTAR AND EPOXYPOLYMER CONCRETE OVERLAY~~

SECTION 623.10 CONCRETE BONDING COMPOUND.

623.10.1 Description. This work shall consist of preparing the surface, furnishing and applying the concrete bonding compound to be used to bond plastic concrete mortar to hardened concrete as shown on the plans or as directed by the engineer.

623.10.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Type II Epoxy	1039

623.10.3 Construction Requirements.

623.10.3.1 Surface Preparation. The surface of the hardened concrete to which the plastic concrete mortar is to be bonded shall be surface dry and thoroughly cleaned such that all loose and unsound concrete is removed prior to application of the bonding agent.

623.10.3.2 Application. The bonding agent shall be applied when both the air and surface temperature is within the manufacturer's written recommendations.

623.10.3.2.1 Components shall be mixed in accordance with manufacturer's written recommendations. The components may be warmed with indirect heat to a maximum temperature of 100 F to reduce the viscosity. No solvents shall be added to the compound.

623.10.3.2.2 The mixed bonding agent shall be applied in such a manner as to thoroughly work the bonding compound into the hardened concrete surface. The thickness of the application shall be 20 to 25 mils. If the concrete absorbs the bonding agent, additional coats shall be applied until the correct thickness is attained.

623.10.3.2.3 The plastic concrete mortar shall be placed while the bonding agent is still tacky. If there is a delay in placing the plastic concrete mortar and the bonding agent becomes tack free, another coat of bonding agent shall be applied.

623.10.4 Basis of Payment. No direct payment will be made for furnishing material, surface preparation or application.

SECTION 623.20 EPOXY MORTAR.

623.20.1 Description. This work shall consist of preparing the surface, furnishing and applying epoxy mortar as shown on the plans.

623.20.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Type III Epoxy	1039
Sand for Epoxy Mortar	1039

623.20.3 Construction Requirements.

623.20.3.1 Surface Preparation. The surfaces to which the epoxy mortar is to be applied shall be free of dust, water or any other material that may affect the adhesion.

623.20.3.2 Application. The epoxy mortar shall be prepared and placed when the weather is dry and the air temperature is in accordance with the manufacturer's written recommendations.

623.20.3.2.1 The contractor shall mix only the number of containers of material that can be placed in 20 to 40 minutes.

623.20.3.2.2 Epoxy shall be thoroughly mixed in accordance with the manufacturer's written recommendations. Mixing shall continue as permitted to ensure uniformity.

623.20.3.2.3 When the epoxy material has been thoroughly mixed, sand shall be added at the manufacturer's recommended rate while mixing continues. After the proper quantity of sand has been added, mixing shall continue until the mixture is uniform.

623.20.3.2.4 Areas to be patched or leveled shall be thoroughly primed with an application of neat epoxy. After the area is primed, the mortar shall be placed and struck off to grade. The surface shall have a rough finish equal to that of a Portland cement concrete deck.

623.20.3.2.5 The patched or leveled area shall be protected during the curing period to prevent damage. Material shall be cured in accordance with the manufacturer's written recommendations. Curing acceleration by direct flame application will not be permitted.

623.20.4 Basis of Payment. No direct payment will be made for furnishing material, surface preparation or application.

SECTION 623.30 EPOXY POLYMER WEARING SURFACE ~~CONCRETE OVERLAY~~.

623.30.1 Description. This work shall consist of constructing an epoxy polymer wearing surface ~~furnishing and applying thin polymer~~on a prepared surface in accordance with this specification, as shown on the plans or as directed by the engineer. Epoxy polymer wearing surface shall be composed of the following components - ~~concrete overlays in a~~ prime coat~~, plus~~ and two courses of epoxy polymer and aggregate. ~~on designated bridge structures as shown on the plans or as directed by the engineer.~~

623.30.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
~~Epoxy Resin for~~ Epoxy Polymer Wearing Surface ~~Concrete Overlay~~	1039
~~Aggregate for Epoxy Polymer Concrete Overlay~~	~~1039~~

623.30.3 Construction Requirements.

623.30.3.1 Manufacturer Representation. The ~~overlay~~wearing surface manufacturer's representative shall witness the entire testing phase of each field test. The manufacturer's representative shall verify that all operations are performed by acceptable practices.

623.30.3.2 Handling and Storage of Material. Handling and storage of material shall be in accordance with the manufacturer's written recommendations.

623.30.3.3 Field Test. Prior to the start of the ~~overlay~~wearing surface operation, a test area of the complete ~~overlay~~wearing surface system shall be placed on the bridge deck in a contractor proposed location that is approved by the engineer. When multiple bridges are included in a project, a test area will be required on each bridge. The contractor may utilize one-half of the bridge deck or an area equal to one day's placement operation, whichever is smaller, as a field test. The degree of cleaning used on the test area shall be the minimum used on the remainder of the structure. The surface for the test ~~overlay~~wearing surface shall be prepared in accordance with the test method prescribed in ACI 503R - Appendix A of the ACI Manual of Concrete Practice to establish an approved cleaning practice. The approved cleaning practice shall remove all potentially detrimental material which may interfere with the bonding or curing of the ~~overlay~~wearing surface. Concrete shall be sound, with mortar soundly bonded to the coarse aggregate, with clean and open pores to be considered adequate for bond. All areas of asphalt and pavement markings shall be removed. Preparation of the surface shall produce a surface relief equal to International Concrete Repair Institute (ICRI) surface preparation level 6 or 7 or ASTM E 965 pavement macrotexture depth of 0.04 to 0.08 inch.

623.30.3.3.1 Visible moisture on the prepared deck at the time of placing the ~~overlay~~wearing surface will not be permitted. Moisture in the deck shall be checked by taping a plastic sheet to the deck for a minimum of 2 hours in accordance with ASTM D4263.

623.30.3.3.2 In addition to the above requirements, the cleaning practice shall provide an adhesion strength test result greater than 250 psi or a failure area into the base concrete that is greater than 50 percent of the test area. After the test area has cured for a minimum of 72 hours, adhesion shall be checked in accordance with ACI 503R. A test result will be the average of three tests on a sample area of the test patch. A minimum of three sample areas per test patch shall be tested. Successful test results will be required from each sample area.

623.30.3.3.3 If the test of a sample area fails to meet the above requirements due to a cohesive failure of the substrate concrete, the adhesive strength of the sample area will be considered acceptable.

623.30.3.3.4 Successful completion of the adhesion strength tests will be required before the full-scale ~~overlay~~wearing surface operation is to begin. All cleaning operations shall equal those used for the adhesion strength test areas, in both profile and cleanliness. If changes are made to the established cleaning practice, new adhesion strength testing shall be performed at the contractor's expense.

623.30.3.3.5 Test patches shall be installed with the same material, equipment, personnel, timing, sequence of operations and curing period that will be used for the installation of the ~~overlay~~wearing surface.

623.30.3.3.6 If the test fails, the contractor shall remove the material represented by the failed test patches and provide another test patch, at the contractor's expense, until satisfactory test results are obtained.

623.30.3.4 Surface Preparation. Before placement of the ~~overlay~~wearing surface, the entire deck surface shall be prepared by the cleaning practice established in the field adhesion strength tests in accordance with Sec 623.30.3.3 by shot blast method.~~, except that~~ S~~s~~and blasting will

not be permitted. ~~Containment~~ Clean-up and disposal of blast material shall be in accordance with Sec 202.3.1.3~~2~~.

623.30.3.4.1 If the engineer determines that the weather has changed significantly since the application of the field test patch, the contractor shall verify through adhesion strength tests that the practice is acceptable, at the contractor's expense.

623.30.3.4.2 No traffic of any kind shall be permitted on any portion of the deck which has been shot blasted or on the ~~overlay~~wearing surface without approval from the engineer. The time between surface preparation and application of the first course shall not exceed 24 hours.

623.30.3.4.3 All patching and cleaning operations shall be inspected and approved prior to placing the ~~overlay~~wearing surface.

623.30.3.4.4 If the deck or intermediate course is contaminated by foreign material or water after initial cleaning, the contamination and any detrimentally affected ~~overlay~~wearing surface material shall be removed. Both courses shall be applied prior to opening the area to traffic.

623.30.3.5 Equipment. The contractor's equipment shall be as recommended by the epoxy manufacturer.

623.30.3.6 ~~Epoxy~~ Mixing~~ture~~. Mixing of epoxy polymer components shall be in accordance with the manufacturer's recommendations, except that the use of a volumetric mixer will be required. When mineral fillers are specified, the mineral fillers shall be inert and non-settling or readily dispersible. Material showing a permanent increase in viscosity or the settling of pigments that cannot be readily dispersed with a paddle shall be replaced at the contractor's expense. At least 95 percent of the filler shall pass the No. 200 sieve.

623.30.3.7 Application. Application of epoxy polymer shall be performed by the ~~supplier~~ manufacturer or by a factory trained or licensed applicator with written approval from the manufacturer of the epoxy system.

623.30.3.7.1 The handling and mixing of epoxy polymer shall be in accordance with the manufacturer's written recommendations. The epoxy polymer ~~overlay material~~ shall not be placed when weather or surface conditions are such that the material cannot be properly handled, placed and cured within the specified requirements of traffic control, or when rain is forecasted within 24 hours of application.

623.30.3.7.2 The ~~overlay~~wearing surface shall consist of a two-course application of epoxy polymer and aggregate. A prime coat shall be used if recommended by the manufacturer. Each of the two courses shall consist of a layer of epoxy polymer covered with a layer of aggregate in sufficient quantity to completely cover the epoxy polymer. The thickness of each course shall be approximately equal. The total thickness of the ~~overlay~~wearing surface shall be no less than 1/4 inch.

623.30.3.7.3 The temperature of the bridge deck surface at the time of application shall be less than 90 F and in accordance with the manufacturer's recommendation.

623.30.3.7.4 Dry aggregate shall be applied in such a manner as to cover the epoxy polymer ~~mixture~~ completely within 5 minutes of application. The dry aggregate shall be placed in a manner such that the level of the epoxy polymer ~~mixture~~ is not disturbed.

623.30.3.7.5 The first course shall be swept to remove loose aggregate prior to the second course application. Sweeping shall be done without removing embedded aggregate. First course applications which do not receive enough aggregate prior to gelling shall be removed and

replaced. A second course applied with insufficient aggregate may be left in place, but additional applications shall be placed at the contractor's expense before opening to traffic.

623.30.3.7.6 The thickness of the ~~overlay~~wearing surface shall be verified to be at least 1/4~~-~~ inch, measured from the deck surface to the top of the epoxy polymer ~~resin~~. The contractor shall provide a minimum 1/2-inch diameter hole at a rate of at least one hole per 100 feet of traffic lane. Hole placement shall be at locations designated by the engineer. Thin areas shall be recoated and reverified at the contractor's expense.

623.30.3.7.7 When additional applications or recoating are required, the engineer may require additional adhesion strength tests by the contractor, at the contractor's expense, in accordance with ACI 503R to verify the contractor's procedure.

623.30.3.7.8 All adhesion strength test areas, thickness test holes or any debonded areas shall be repaired by filling with ~~overlay~~wearing surface material before final acceptance.

623.30.3.7.9 The first epoxy polymer course ~~concrete overlay~~ shall be cured at least one hour, or until brooming or vacuuming can be performed without tearing or otherwise damaging the surface. No traffic or equipment shall be permitted on the ~~overlay surface~~ first course during the curing period.

623.30.3.7.10 After the curing period, all loose aggregate shall be removed by brooming or vacuuming and the next epoxy polymer ~~overlay~~ course applied as specified in the contract documents.

623.30.3.7.11 The epoxy polymer mixture shall not be permitted to run into drains.

623.30.3.7.12 Unless otherwise specified, the epoxy polymer ~~concrete overlay~~ courses shall be applied over the expansion joints and joint seals of the bridge deck. The expansion joints and joint seals shall be provided with a bond breaker. Prior to opening to traffic, the ~~overlay~~wearing surface shall be removed over each joint by removal of the bond breaker in accordance with the epoxy polymer ~~overlay~~ manufacturer's recommendations.

623.30.3.7.13 Prior to opening a section to public or construction traffic, the ~~overlay~~wearing surface shall be allowed to cure in accordance with the manufacturer's recommendations. First course applications shall not be opened to traffic.

623.30.3.7.14 Damaged or debonded areas of an epoxy polymer ~~concrete overlay~~ course shall be removed and repaired prior to acceptance. Repair shall consist of saw-cutting in rectangular sections to the top of the concrete deck surface and replacing the various courses in accordance with this specification at the contractor's expense.

623.30.4 Method of Measurement. Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, the area of epoxy polymer ~~concrete overlay~~ wearing surface will be measured ~~and computed~~ to the nearest square yard based on measurement ~~. This area will be measured~~ longitudinally from end to end of bridge deck and transversely between ~~the~~ roadway face of curbs, excluding the area of ~~the~~ any expansion devices~~, if any~~. The revision or correction will be computed and added to or deducted from the contract quantity.

623.30.5 Basis of Payment. The accepted quantity of epoxy polymer wearing surface ~~concrete overlay~~ will be paid for at the contract unit price. Payment will be considered full compensation for all labor, equipment and material necessary to complete the described work.

SECTION 623.40 POLYMER CONCRETE.

623.40.1 Description. This work shall consist of furnishing and placing polymer concrete as shown on the plans or as directed by the engineer.

623.40.2 Manufacturer Representation. The manufacturer's representative shall be present at the start of surface preparations and polymer concrete installation for at least one day. The contractor shall furnish the manufacturer's recommendations to the engineer as to the acceptability of all aspects of the operation. The contractor shall contact the manufacturer's representative at least two weeks prior to installation.

623.40.3 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Polymer Concrete	1039

623.40.4 Construction Requirements.

623.40.4.1 Equipment. The contractor's equipment shall be in accordance with the manufacturer's recommendations.

623.40.4.2 Surface Preparation. Portland cement concrete shall be allowed to cure and dry for a minimum of seven dry days prior to installing the polymer concrete. Days with cold, wet or inclement weather which may be a detriment to curing of the Portland cement concrete will not count in this seven day minimum curing and drying time. The concrete surface shall be dry when placing the polymer concrete. The substrate shall be structurally sound and sand or shot blasted to be free of all foreign matter, grease, dirt and laitance for all areas that will be in contact with the polymer concrete. Steel surfaces shall be cleaned in accordance with SSPC-SP 10 surface preparation requirements. ~~Containment~~ Clean-up and disposal of blast material shall be in accordance with Sec 202.3.1.3~~2~~. After sand or shot blasting is completed, the joint shall be cleaned of debris by using oil and water free compressed air at a minimum of 90 psi or by vacuuming. These areas shall then be primed in accordance with the manufacturer's recommendations.

623.40.4.3 Placement. The polymer concrete shall be mixed, placed and cured in accordance with the manufacturer's recommendations and as shown on the plans. Before opening to traffic, the material shall be tack free and fully cured as determined by the engineer.

623.40.5 Method of Measurement. Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, the volume of polymer concrete will be measured to the nearest 1.0 cubic feet of accepted, in-place polymer concrete. The revision or correction will be computed and added to or deducted from the contract quantity.

623.40.6 Basis of Payment. The accepted quantity of polymer concrete will be paid for at the contract unit price.

SECTION 623.50 METHYLMETHACRYLATE POLYMER SLURRY WEARING SURFACE.

623.50.1 Description. This work shall consist of constructing a methylmethacrylate (MMA) polymer slurry wearing surface on a prepared surface in accordance with this specification as shown on the plans or as directed by the engineer. MMA polymer slurry wearing surface shall be composed of the following components – MMA primer; MMA polymer slurry; broadcast aggregate; and MMA top coat.

623.50.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
MMA Polymer Surry Wearing Surface	1039

623.50.2.1 Mixing and Application. Mixing and application shall be done in accordance with the manufacturer's recommendations.

623.50.2.2 Delivery of Material. All material shall be delivered in their original containers bearing the manufacturer's label, specifying date of manufacturing, batch number, trade name, and quantity. Each shipment shall be accompanied by a MSDS.

623.50.2.3 Storage of Material. The material shall be stored to prevent damage by the elements and to ensure the preservation of their quality and fitness for the work. The containers shall be stored in a manner that will not allow leakage or spillage from one material to contact the containers or material of the other. The storage space shall keep the material clean and dry and shall contain a high-low thermometer. The temperatures of the storage space shall not fall below nor rise above that recommended by the manufacturer. Every precaution shall be taken to avoid contact with flame.

623.50.2.3.1 Stored material shall be inspected prior to their use and shall meet the requirements of this specification at the time of use.

623.50.2.3.2 Sufficient material to perform the entire MMA polymer slurry wearing surface application shall be in storage at the site prior to any field application, so that there shall be no delay in procuring the material for each day's application.

623.50.2.4 Training. The contractor shall arrange to have the material supplier furnish technical service related to application of material and health and safety training for personnel who are to handle the material.

623.50.2.5 Technical Support. The material supplier shall have a representative onsite during the surface preparation and placement of the wearing surface. The material representative shall provide onsite consultation as Quality Control of the installation of the product, but the engineer will have final decision-making authority in all matters.

623.50.3 Preconstruction Requirements.

623.50.3.1 Experience. The contractor shall have experience placing similar thin polymer wearing surfaces on at least three structures prior to doing work on this project. Written proof of this experience along with project contacts shall be provided to the engineer in writing for approval prior to the preconstruction meeting. Prior to installation of the wearing surface, the contractor shall also provide certification by the material supplier that the contractor is a trained and qualified installer of the selected wearing surface.

623.50.3.2 Mix and Application Procedure. The contractor shall prepare and submit all applicable mixing and application procedures to the engineer for approval prior to the preconstruction meeting. The contractor shall not begin ordering materials for application of the wearing surface until the mixing and application procedures are approved. All equipment and materials used in the mixing and application procedure shall be in accordance with the manufacturer's requirements.

623.50.4 Construction.

623.50.4.1 Trial Area. The contractor shall demonstrate their proficiency by preparing and placing the wearing surface on a 10-foot by 10-foot area (or approved equivalent area) prior to the placement of the production wearing surface. The engineer shall select the location of the trial area. Final wearing surface production shall not proceed without the approval of the engineer.

623.50.4.2 Deck Preparation.

623.50.4.2.1 Procedure. The contractor shall submit in writing to the engineer for approval the deck preparation procedure. The contractor's procedure shall include, but not be limited to; equipment used for surface preparation and deck cleaning, shot size, rate of speed to achieve required profile and method of surface profile testing for Quality Control.

623.50.4.2.2 Existing Wearing Surface. On existing concrete decks with an existing wearing surface, the wearing surface shall be removed and the exposed concrete surface shall be prepared in accordance with Sec 623.50.4.2.4.

623.50.4.2.3 Unsound Deck. Any areas of unsound deck encountered shall be completely removed to sound, natural concrete. Polymer concrete or other patching material, approved by the engineer, may be used to repair the deck. Surfaces of concrete patches shall be prepared in the same manner as the rest of the deck. Any new concrete or concrete patches shall cure a minimum of 28 days prior to application of overlay system. All deck repairs shall be in accordance with Sec 704.

623.50.4.2.4 Surface Preparation. The concrete surface shall be prepared in accordance with Sec 623.30 by shot blast method except as specified herein.

623.50.4.2.4.1 The contractor shall remove pavement marking and other surface contaminants. Upon approval by the engineer, scarifiers or hand grinders may be used to aid in the removal of pavement marking and other surface contaminants but shot blast will still be required for final acceptable surface preparation.

623.50.4.2.4.2 The contractor shall remove residual bituminous based crack sealer and any debris from the entire deck including: within cracks, pop-outs or other deck irregularities, tining grooves, deck grooves, gutter lines or any other areas that have trapped material. Removal shall be to the satisfaction of the engineer. The contractor shall be responsible to make note of the deck conditions prior to bidding.

623.50.4.2.5 Reflective Cracks. Reflective cracks in the deck shall be prepared if specified on the plans. The deck shall be blasted to clean out cracks and be dry prior to priming. Before starting priming operations, all cracks shall be blown out with dry high-pressure air.

623.50.4.2.5.1 Reflective cracks or any open cracks greater than 0.06 inch shall be treated to keep the primer material from leaking through the joints of the deck panels below.

623.50.4.2.5.2 All panel deck joints below open deck cracks greater than 0.06 inch shall be identified, mapped and sealed from below at the panel joints with a material resistant to effects of the deck primer to prevent leakage of the deck primer through the bridge deck.

623.50.4.2.5.3 After sealing of the required deck panel joints from below, deck cracks above greater than 0.06 inch shall be prefilled with deck primer.

623.50.4.2.5.4 After cracks greater than 0.06 inch are prefilled, a flood primer application shall be done to the concrete surface to fill all other smaller and fine cracks.

623.50.4.3 Application of Wearing Surface.

623.50.4.3.1 General. The primer, slurry or top coat shall not be permitted to run into drains. Unless otherwise specified, the wearing surface shall not be applied over the expansion joints and joint seals of the bridge deck. Prior to opening a section to public or construction traffic, the wearing surface shall be allowed to cure in accordance with the manufacturer's recommendations. Surfaces with primer only shall not be opened to traffic. During primer, slurry and top coat applications; the contractor shall provide neat clean lines for staging, joints, obstacles or any break in production.

623.50.4.3.1.1 The wearing surface shall not be placed when the relative humidity is above 90 percent.

623.50.4.3.2 Prime Coat. One coat of the MMA primer coat shall be applied to the prepared concrete surfaces immediately before placing the MMA polymer slurry in accordance with the manufacturers recommended procedures. The prime coat shall be uniformly applied to completely cover the surface to receive the MMA polymer slurry. The area receiving the prime coat shall be dry and had no exposure to any moisture within the past 24 hours. Prior to applying the prime coat, the surface shall be cleaned with compressed air to remove accumulated dust and any other loose material. Do not allow traffic on the prepared surface prior to wearing surface placement.

623.50.4.3.2.1 The concrete bridge deck surface shall be between 45 F and 90 F when applying the prime coat.

623.50.4.3.2.2 If the primed surface becomes contaminated, the contaminated area shall be cleaned by abrasive blasting and re-primed at no additional expense to the department.

623.50.4.3.3 MMA Polymer Slurry. The MMA polymer slurry shall be placed on the prime coat according to the manufacturer's recommendations, but no later than two hours after placing the prime coat.

623.50.4.3.3.1 The surface temperature of the area to receive the MMA polymer slurry shall be the same as specified in Sec 623.50.4.3.2.1 or as approved by the manufacturer's representative.

623.50.4.3.3.2 The contractor shall prevent any cleaning chemicals from reaching the MMA polymer slurry components during the mixing operation.

623.50.4.3.3.3 The MMA polymer slurry shall be placed at a minimum thickness of 1/4 inch and a maximum of 3/8 inch.

623.50.4.3.4 Broadcast Aggregate. Dry aggregate shall be applied in such a manner as to cover the MMA polymer slurry completely within 5 minutes of application prior to the gelling of the MMA polymer slurry. The dry aggregate shall be placed in a manner such that the level of the MMA polymer slurry is not disturbed.

623.50.4.3.4.1 After the MMA polymer slurry curing period, all loose aggregate shall be removed by brooming or vacuuming. Any loose aggregate reclaimed for reuse as broadcast aggregate shall be approved by the engineer. At a minimum the reclaimed aggregate shall be screened and verified to be clean, uncontaminated and dry. All reclaimed aggregate must be in conformance with the requirements in Sec 623.50.2.

623.50.4.3.5 Top Coat. The surface should be dry and the top coat should not be allowed to puddle. Top coat shall be placed no later than two hours after the slurry has cured. During the course of work, the contractor shall ensure that top coat is applied to all wearing surface areas prior to any forecasted rain events.

623.50.4.4 Testing. Bond testing shall be performed for each bridge placement per stage on each day. Testing will be conducted at three locations 24 hours after placement. Testing will be performed in accordance to ASTM C 1583. A passing test is the failure of the concrete substrate or bond strength above 250 psi. Do not perform tests if the deck temperature is above 90 F.

623.50.4.4.1 All adhesion strength test areas, thickness test holes or any debonded areas shall be repaired by filling with wearing surface material before final acceptance.

623.50.4.4.2 Any material which is rejected because of failure to meet the required tests or that has been damaged so as to cause rejection shall be immediately replaced at the contractor's expense.

623.50.4.4.3 Damaged or debonded areas of the wearing surface shall be removed and repaired prior to acceptance. Repair shall consist of saw-cutting in rectangular sections to the top of the concrete deck surface and repairing using the same procedure called for in the specification. All repairs shall be at the contractor's expense.

623.50.5.0 Method of Measurement. Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, the area of MMA polymer slurry wearing surface will be measured to the nearest square yard based on measurement longitudinally from end to end of bridge deck and transversely between roadway face of curbs, excluding the area of any expansion devices. The revision or correction will be computed and added to or deducted from the contract quantity.

623.50.6.0 Basis of Payment. The accepted quantity of MMA polymer slurry wearing surface will be paid for at the contract unit price. Payment will be considered full compensation for all labor, equipment and material necessary to complete the described work.

SECTION 704

CONCRETE MASONRY REPAIR

704.1 Description. This work shall consist of removing deteriorated concrete, preparing the repair site, forming where required, placing and finishing new concrete or qualified special mortar, applying epoxy and applying concrete crack filler in the required areas.

704.2 Material. All material shall be in accordance with Division 1000, Material Details, and specifically as follows. The qualified special mortar shall be from the qualified rapid set concrete patching material listing available from Construction and Materials or MoDOT's website.

Item	Section
Concrete	501
Concrete Bonding Compound and Epoxy Mortar	623
Gradation E Coarse Aggregate	1005
Type III Cement	1019
Type III Epoxy ~~&~~ or Epoxy Material for the Polymer Wearing Surface ~~Concrete Overlay~~	1039
Concrete Crack Filler	1053
Water	1070

704.3 Types of Repair.

704.3.1 Half-Sole Repair~~ing Concrete Deck (Half-Soling)~~. This work shall consist of partial removal and replacement of bridge deck concrete in the required areas. Repair areas shall consist of deck imperfections exposing the upper layer of the top mat of reinforcing steel a 1/4 inch. Slight deck imperfections less than 1/2 inch will not be repaired for bridge decks to be covered with an asphalt or concrete wearing surface. Slight deck imperfections less than 1/4 inch will not be repaired for bridge decks to be covered with a seal coat, polymer type wearing surface or no wearing surface.

704.3.2 Deck Repair With Void Tube Replacement. This work shall consist of partial removal and replacement of bridge deck concrete and removal and replacement of the deteriorated void tube in the required areas.

704.3.3 Full Depth Repair. This work shall consist of complete removal and replacement of the bridge deck concrete in the required areas and for voided slabs, the removal and replacement of the deteriorated void tube in the required areas.

704.3.4 Modified Deck Repair. This work shall consist of the removal ~~and replacement~~ of visibly loose or spalled bridge deck concrete and placement of Class B-1 concrete or qualified special mortar in the areas where the reinforcing steel is exposed. If reinforcing steel is not exposed, the asphalt wearing surface in accordance with Sec 403 shall be placed monolithically into the deck imperfections. ~~The repair concrete for these areas shall be Class B-1.~~

704.3.5 Superstructure Repair (Unformed). This work shall consist of repairing the deteriorated concrete on the bottom of the bridge deck in the required areas with a qualified special mortar.

704.3.6 Slab Edge Repair. This work shall consist of repairing the edge of the bridge deck by removing deteriorated concrete and patching the required areas with a qualified special mortar. All repairs made within 4 inches of the edge of the bridge deck, regardless of the repair thickness, will be considered slab edge repair. Portions of the bridge deck areas requiring repair that extend more than 4 inches from the edge of the bridge deck shall be repaired as superstructure repair (unformed) or full depth repair.

704.3.7 Substructure Repair (Formed). This work shall consist of formed substructure repair. The required areas shall be patched with Class B-1 concrete. Coarse aggregate shall be Gradation E in accordance with Sec 1005. The extent of a single formed repair area for measurement shall be the contiguous concrete surfaces that meet at a formed edge.

704.3.8 Substructure Repair (Unformed). This work shall consist of unformed substructure repair. The required areas shall be patched with a qualified special mortar.

704.3.9 Epoxy Sealing. This work shall consist of applying an epoxy material to the concrete in the required areas.

704.3.10 Concrete Crack Filler. This work shall consist of applying a concrete crack filler to the concrete in the required areas.

704.3.11 Monolithic Deck Repair. This work shall consist of providing and placing supplementary wearing surface material necessary to fill all depressions in the deck below the bottom of the planned deck wearing surface thickness. This material is placed monolithic during the deck wearing surface process.

704.3.12 Shallow Deck Repair. This work shall consist of removal of bridge deck concrete in required areas and placing polymer concrete per Sec 623.40. Repair areas shall consist of deck imperfections deeper than 1/4 inch to a depth where reinforcing steel is not exposed. Slight deck imperfections less than 1/4 inch will not be repaired.

704.4 Construction Requirements for Non-Hydro Demolition Projects.

704.4.1 Removal Requirements.

704.4.1.1 General. The type of repair and areas to be repaired will be outlined by the engineer. Determination of deck repair areas will be by sounding except when modified deck repair is specified. All loose, deteriorated and unsound concrete in the required repair areas shall be removed by conventional hand/mechanical~~, hydro demolition~~ or other approved equipment~~ to a depth as specified herein and as directed by the engineer. Slight deck imperfections surrounded by sound concrete shall be cleaned of all dirt, loose material and deteriorated concrete. If reinforcing steel is not exposed, deck repair work will not be required~~.

~~**704.4.1.1 Bridge Decks to be Covered with Asphalt or Concrete Wearing Surface.** The existing bridge deck shall be scarified for the concrete wearing surface as specified in the contract documents and in accordance with Sec 505. Slight bridge deck imperfections of 0.5 inch or less in depth below the prepared deck surface that are surrounded by sound concrete, and the reinforcing steel is not exposed, shall not be half-soled. These areas shall be cleaned by hand tools, sand or hydro blasting to remove all dirt, loose material and deteriorated concrete before the application of the asphalt or concrete wearing surface. Asphalt or concrete for these areas shall be placed monolithic with the wearing surface in accordance with Sec 403 or Sec 505.~~

~~**704.4.1.2 Bridge Decks to be covered with Epoxy Polymer Concrete Overlay.** Preparing and cleaning the existing bridge deck shall be in accordance with Sec 623.~~

704.4.1.2~~3~~ Conventional Hand/Mechanical Equipment. For bridge decks rated 6 or above, ~~C~~conventional hand/mechanical equipment consisting of jackhammers no heavier than the 35-pound class shall be used for concrete removal except that for modified deck repair chip hammers no heavier than 15-pound class shall be used. For bridge decks rated 5 or below, the jackhammers shall not be heavier than the 65-pound class except for modified deck repair. Chipping hammers from the 15-pound class shall be used to remove concrete from beneath any reinforcing bars, where required. The bits shall be sharp in order to reduce pounding. Jackhammers shall be operated to minimize damage to the sound concrete around the patch area. Other methods that would be less damaging to the concrete and reinforcement may be used with approval from the engineer.

~~**704.4.1.4 Patch Repair Hydro Demolition Equipment.** The hydro demolition equipment shall be capable of removing concrete to the specified depth and shall be capable of removing rust and concrete particles from exposed reinforcing bars. All water used in hydro demolition shall be potable in accordance with Sec 1070. Stream or lake water will not be permitted. The contractor shall take necessary precautions during hydro demolition to prevent damage to the remaining structure and adjacent property as a result of runoff. Slab drains receiving runoff from the contractor's operation shall be temporarily plugged. The discharge water shall not be released from the site until the broken concrete, aggregate and other settleable solids have been removed through filtration, sediment basins or other approved methods. The contractor shall control dust and run-off in accordance with applicable governmental regulations. Environmental protection shall be in accordance with Sec 107. Hydro demolition shall not impede or interfere with maintaining traffic. Heavy equipment, such as vacuum trucks for removal of concrete debris, will not be permitted to place wheel loads on the deck areas where deteriorated concrete has been removed.~~

704.4.1.3~~5~~ Concrete Removal. A boundary perimeter with one-inch vertical sides shall be established outside the deteriorated area. The deteriorated concrete shall be removed as required to provide good sound concrete on which new concrete can be placed and satisfactorily bonded to the reinforcing bars. The areas of repair shall be made approximately rectangular with the sides generally perpendicular to the surface being repaired. These areas shall be carefully removed such that reinforcement is not disturbed or damaged. For full depth repair, a saw cut outside the deteriorated area shall also be made on the bottom of the bridge deck, except on voided slab, solid slab and box girder bridges without entry access. Other acceptable methods for saw cutting the bottom of the deck may be used with approval from the engineer. No more than one-fourth of the column perimeter shall be removed at any one time, and no more than one-eighth of the column perimeter if the repair is completed under live load. Once the one-quarter or one-eighth limit has been reached, the column shall be repaired before any further column removal is done.

704.4.1.4~~6~~ Reinforcing Bar Exposed. All exposed reinforcing bars shall be thoroughly cleaned by sand, shot or hydro blasting to the satisfaction of the engineer.

704.4.1.6~~4~~.1 ~~Superstructure and Substructure Repair.~~ The concrete within the boundary area for superstructure repair (unformed), substructure repair (formed) and substructure repair (unformed) shall be removed a minimum of one inch beyond the inside edge of any exposed reinforcing bars, including the main reinforcement.

704.4.1.4~~6~~.2 ~~Deck Repairs.~~ ~~The minimum depth of repair for repairing concrete deck (half-soling) or modified deck repair shall expose the upper layer of the top mat of reinforcing steel.~~ When the bond between existing concrete and a reinforcing bar has been destroyed, or more than half the diameter of a reinforcing bar is exposed during half-sole and modified deck repair,

the concrete adjacent to the reinforcing bar shall be removed to a depth that will permit the concrete to bond to the entire periphery of the bar. A minimum of one-inch clearance shall be maintained.

704.4.1.4~~6~~.3 If a reinforcing bar is exposed during slab edge repair, the concrete adjacent to the bar shall be removed to a depth that will permit a qualified special mortar to bond to the entire periphery of the bar. A minimum of one-inch clearance shall be maintained.

704.4.1.5~~7~~ Reinforcement Repair. Particular care shall be taken not to disturb or damage reinforcing bars. All exposed reinforcing bars shall be thoroughly cleaned by sand, shot or hydro blasting. Cut or broken bars or bars with 25 percent or more cross sectional area lost shall be spliced 24 diameters on each side of the damage with new bars of the same size in accordance with Sec 706. Damaged existing epoxy coated reinforcement shall be repaired in accordance with Sec 710.

704.4.1.6~~8~~ Material Disposal. All material removed shall be disposed of in accordance with Sec 202.

704.4.2 Preparation of the Repair Area.

704.4.2.1 Concrete Repair ~~Patch Preparation Requirements~~. After removal of deteriorated concrete, the area to be repaired shall be sand, shot or hydro blasted to remove all foreign matter, dirt, free standing water and loose material and micro-cracking. ~~Containment~~ Clean-up and disposal of blast material shall be in accordance with Sec 202.3.1.3~~2~~. ~~The hydro-demolition process will not require sand or additional hydro blasting unless the bonding surface of the repair area becomes contaminated or unsatisfactory prior to placement of new concrete.~~ The area to come in contact with new concrete shall be cleaned as stated above, saturated with water and painted with a concrete bonding compound or an epoxy mortar prior to placing the ~~placement of~~ new concrete. A concrete bonding compound shall be used for all structures with the following exception. An epoxy mortar shall be used on box girder, voided and solid slab structures and on structures where a cathodic protection system is to be installed.

704.4.2.2 Epoxy Sealing ~~Preparation~~. The area to be sealed shall be cleaned by sand or shot blasting. ~~Containment~~ Clean-up and disposal of blast material shall be in accordance with Sec 202.3.1.3~~2~~. Prior to sealing the concrete, all loose particles and foreign matter shall be removed using oil-free and water-free compressed air or a vacuum of at least 90 psi.

704.4.2.3 Concrete Crack Filler ~~Preparation~~. The area to fill the cracks shall be cleaned by pressure washing with at least 2500 psi, 3 days minimum prior to the crack filler application and 2 days after any measurable precipitation.

704.4.3 Placement of Repair Material.

~~**704.4.3 Applying Epoxy.** The area to be sealed shall be sealed with a qualified Type III epoxy or epoxy material for epoxy polymer concrete overlay. Sealing shall be completed before the application of any overlay. The cleaning, sealing and epoxy application shall proceed only as approved by the engineer, in accordance with the manufacturer's written recommendations. The epoxy application and rate of coverage shall be in accordance with manufacturer's recommendations, with a maximum coverage of 100 square feet per gallon.~~

~~**704.4.3.1 Applying Concrete Crack Filler.** The area to fill the cracks shall be filled with a low viscosity polymer crack filler. The concrete crack filler application and rate of coverage shall be in accordance with the manufacturer's recommendations, with a maximum coverage of 100 square feet per gallon. The broadcasting of dry blasting sand shall be applied only as approved by the engineer, in accordance with the manufacturer's written recommendations with a~~

~~maximum coverage of 1 to 2 lbs/sq.yd. starting approximately 10 minutes after crack filling operation has started.~~

704.4.3.1~~.4 Placement of New~~ Concrete Repair.

~~**704.4.4.1 Concrete Placement Requirements.**~~ Concrete shall be placed before the concrete bonding compound or epoxy mortar has begun to set. Deck repair concrete shall be placed in the repair area to match the top of the original deck surface. For bridges to be covered with concrete wearing surface, deck repair concrete shall be placed in the repair area up to the bottom of the proposed concrete wearing surface. The finished repair area shall have a light broom texture for bonding of the deck seal, except bridges to be covered with concrete wearing surface shall have a rough surface for bonding of the concrete wearing surface. All joints shall be formed to match any existing joint pattern.

704.4.43.1.1~~2 Concrete Requirements.~~ Concrete for concrete deck repair shall be Class B-2~~,~~ except as specified in Sec 704.3.4 and Sec 704.4.4.3.3 and that solid slab, voided slab and box girder structures shall be the same class as the existing deck concrete~~ and as specified in Secs 704.3.4 and 704.4.4.3~~. The repair area shall not be opened to any traffic until the concrete has reached a compressive strength of 3,200 psi. Type III cement may be used to accelerate the set. The coarse aggregate shall be Gradation E in accordance with Sec 1005. Accelerating additives containing chlorides will not be permitted.

704.4.43.1.2~~3 Bridge Decks with Cathodic Protection System.~~ Concrete for repairing bridge ~~the concrete~~ decks with cathodic protection systems shall be Class B-1. The repair area shall not be opened to any traffic until the concrete has reached a compressive strength of 3200 psi. Type III cement may be used to accelerate the set. The coarse aggregate shall be Gradation E in accordance with Sec 1005. Accelerating additives containing chlorides will not be permitted. All half-sole repairs made on the deck shall be Class B-1 concrete that has a maximum chloride ion content of 5 pounds per cubic yard. All full depth repairs made on the deck shall be chloride-free Class B-1 concrete from the bottom of the deck to within one inch of the lowest rebar of the top layer of reinforcing steel. The remainder of the repair shall be Class B-1 concrete with a maximum chloride ion content of 5 pounds per cubic yard.

704.4.43.1.3~~4 Curing.~~ The repaired areas shall be cured in accordance with Sec 703. ~~The cleaning and application of the epoxy polymer concrete overlay to the deck shall proceed only as approved by the engineer in accordance with the manufacturer's written recommendations.~~

704.4.3.2 Epoxy Sealing. The area to be sealed shall be sealed with a qualified Type III epoxy or epoxy material for the polymer wearing surface. Sealing shall be completed before the application of any wearing surface. The cleaning, sealing and epoxy application shall proceed only as approved by the engineer, in accordance with the manufacturer's written recommendations. The epoxy application and rate of coverage shall be in accordance with manufacturer's recommendations, with a maximum coverage of 100 square feet per gallon.

704.4.3.3 Concrete Crack Filler. The area to fill the cracks shall be filled with a low viscosity polymer crack filler. The concrete crack filler application and rate of coverage shall be in accordance with the manufacturer's recommendations, with a maximum coverage of 100 square feet per gallon. The broadcasting of dry blasting sand shall be applied only as approved by the engineer, in accordance with the manufacturer's written recommendations with a maximum coverage of 1 to 2 pounds per square yard starting approximately 10 minutes after crack filling operation has started.

704.5 Construction Requirements for Hydro Demolition Projects.

704.5.1 Zoned Conventional Deck Repair Prior to Hydro Demolition (if specified in the contract).

704.5.1.1 Prior to hydro demolition, the deck shall be repaired inside special repair zones as called for in the contract plans in accordance with Sec 704.4 except as follows:

(a) The removal and replacement of all sound and unsound existing deck repairs shall be considered as half-sole repair in accordance with Sec 704.4.

(b) Monolithic deck repair as specified in Sec 704.5.5 shall be used to replace shallow deteriorated concrete when only half the diameter or less of the top mat of reinforcing steel is exposed.

704.5.2 Conventional Half-Sole Repair After Hydro Demolition.

704.5.2.1 For polyester polymer concrete or low slump concrete wearing surfaces, following removal of unsound original concrete by hydro demolition and hand chipping, any areas requiring half-sole deck repair will be identified by the engineer.

704.5.2.2 All half-sole repair identified by the engineer shall be made prior to the deck wearing surface.

704.5.2.3 Half-sole repair shall be in accordance with Sec 704.4 except that the removal is accomplished by hydro demolition and limited only to locations where the removal of concrete around the perimeter of the top transverse reinforcing steel is required.

704.5.2.4 Concrete or qualified repair mortars used for half-sole repair shall be fully cured prior to the wearing surface.

704.5.3 Conventional Full Depth Repair After Hydro Demolition.

704.5.3.1 Following removal of unsound original concrete by hydro demolition and hand chipping, any areas requiring a full depth repair will be identified by the engineer.

704.5.3.2 For polyester polymer concrete or low slump concrete wearing surfaces on all bridge decks and all concrete wearing surfaces on voided slab bridges, all full depth repair shall be made prior to the deck wearing surface in accordance with Sec 704.4 except that the removal is accomplished by hydro demolition.

704.5.3.3 For concrete wearing surfaces not covered by Sec 704.5.3.2, full depth repair for areas greater than 5 square feet (3 square feet in areas of presstressed panels) shall be made prior to the deck wearing surface in accordance with Sec 704.4 except that the removal is accomplished by hydro demolition and concrete may be placed in the repair area up to one inch below the top mat of reinforcement.

704.5.3.4 If the engineer determines that for concrete wearing surfaces not covered by Sec 704.5.3.2, full depth repair for areas less than or equal to 5 square feet (3 square feet in areas of presstressed panels) can be made monolithic with the new deck wearing surface. The contractor shall form the bottom of the repair prior to the wearing surface. No payment will be made for forming the bottom of full depth monolithic repairs, including form removal.

704.5.3.5 Concrete or qualified repair mortars used for full depth repair shall be fully cured prior to placing the wearing surface.

704.5.4 Void Tube Replacement Requiring Conventional Deck Repair After Hydro Demolition.

704.5.4.1 Following removal of unsound original concrete by hydro demolition and hand chipping, any void tubes requiring replacement will be identified by the engineer.

704.5.4.2 Deck repair required for void tube replacement shall be in accordance with Sec 704 except that the removal is accomplished by hydro demolition

704.5.4.3 Concrete or qualified repair mortars used for deck repair with void tube replacement shall be fully cured prior to placing the wearing surface.

704.5.5 Monolithic Deck Repair After Hydro Demolition.

704.5.5.1 Monolithic deck repair shall not be used with void tube replacement and with polyester polymer or low slump concrete when more than half the diameter of the top bar is exposed.

704.5.5.2 For deck repair and concrete wearing surfaces not covered by Sec 704.5.5.1, shallow and deep areas, including approved full depth repair areas, shall be filled monolithically with the deck wearing surface.

704.6.~~5~~ Method of Measurement. The extent of repair may vary from the estimated quantities, but the contract unit price shall prevail regardless of the variation. Final measurement will not be made for preparation of the existing deck. No duplication of measurement will be made for full depth repair, half-sole repair~~ing concrete deck (half soling)~~, deck repair with void tube replacement, monolithic deck repair, shallow deck repair, slab edge repair, superstructure repair (unformed) or modified deck repair. No duplication of measurement will be made for substructure repair, unformed and formed.

704.6.~~5~~.1 Half-sole ~~R~~repair~~ing concrete deck (half soling)~~, deck repair with void tube replacement, shallow deck repair, full depth repair, modified deck repair, superstructure repair (unformed) and substructure repair (formed and unformed) will be measured to the nearest square foot.

704.6.~~5~~.2 Slab edge repair will be measured to the nearest linear foot.

704.6.~~5~~.3 No measurement will be made for epoxy sealing.

704.6.~~5~~.4 Measurement of reinforcing steel replaced due to excess section loss will be made to the nearest 10 pounds.

704.6.~~5~~.5 Filling concrete cracks will be measured to the nearest square foot.

704.6.6 Supplementary wearing surface material required to fill monolithic deck repair will be measured in accordance with Sec 505.

704.7.~~6~~ Basis of Payment. Accepted quantities of concrete masonry repairs will be paid for at the contract unit price for each of the pay items included in the contract except for the following repairs.

704.7.1 Supplementary wearing surface material required to fill monolithic deck repair will be paid for in accordance with Sec 505.

704.7.2 No direct payment will be made for epoxy sealing.

SECTION 1039

~~EPOXY RESIN MATERIAL~~POLYMER PRODUCTS

SECTION 1039.10 TYPE II EPOXY.

1039.10.1 Scope. This specification covers epoxy resin to be used to bond plastic concrete or mortar to hardened concrete or mortar.

1039.10.2 General Requirements. The epoxy shall be furnished as a system in accordance with the requirements of ASTM C 881, Type II, Grade 2, Class B or C.

1039.10.3 Manufacturer and Brand Name Approval. Prior to approval and use of this material, the manufacturer shall submit to Construction and Materials a certified test report showing specific test results from an independent laboratory in accordance with all requirements of these specifications. The certified test report shall contain the manufacturer's name, brand name of material, lot tested, date of manufacture and ratio of components. In addition, the manufacturer shall submit a one-quart sample of each component, A and B, for laboratory testing accompanied by a technical data sheet and an MSDS. With approval from the engineer of the certified test report and satisfactory results of tests performed on the sample submitted, the brand name and manufacturer will be placed on a qualified list of concrete bonding compounds. New certified test results and samples shall be submitted any time the manufacturing process or the material formulation is changed and may be required when random sampling and testing of material offered for use indicates nonconformity with any of the requirements herein specified.

1039.10.4 Acceptance. To obtain final acceptance of this material, the manufacturer shall furnish certification to the engineer at the destination that the material supplied is in accordance with all requirements specified and stating that the material is the same system and is identically formulated to the material tested for manufacturer and brand name approval.

SECTION 1039.20 TYPE III EPOXY.

1039.20.1 Scope. This specification covers epoxy to be used in the grouting of dry cracks, in epoxy mortar for patching concrete and in epoxy mortar surface leveling.

1039.20.2 General Requirements. The epoxy shall be furnished as a system in accordance with the requirements of ASTM C 881, Type III, Grade 1, Class B or C.

1039.20.3 Manufacturer and Brand Name Approval. Prior to approval and use of this material, the manufacturer shall submit to Construction and Materials a certified test report showing specific test results from an independent laboratory in accordance with all requirements of these specifications. The certified test report shall contain the manufacturer's name, brand name of material, lot tested, date of manufacture and ratio of components. In addition, the manufacturer shall submit a one-quart sample of each component, A and B, for laboratory testing accompanied by a technical data sheet and an MSDS. With approval from the engineer of the certified test report and satisfactory results of tests performed on the sample submitted, the brand name and manufacturer will be placed on a qualified list of concrete bonding compounds. New certified test results and samples shall be submitted any time the manufacturing process or the material formulation is changed and may be required when random

SECTION 1039.60 EPOXY POLYMER WEARING SURFACE ~~CONCRETE OVERLAY~~.

1039.60.1 Scope. This specification covers ~~an~~ epoxy polymer and aggregate to be used for an epoxy polymer wearing surface. ~~concrete overlay system consisting of an epoxy resin material and aggregate for use on bridge deck surfaces.~~

1039.60.2 Epoxy Polymer ~~Resin Material~~. The infrared spectrum for each component of the epoxy polymer ~~resin material~~ shall essentially match that of the standard infrared spectrum for the particular component as specified in AASHTO T 237, Sections 4 and 5. The epoxide equivalent for Component A shall not exceed 270. The mixed epoxy polymer shall meet the following requirements:

~~Epoxy Resin Requirements~~	
Property	**~~Specific Value~~Requirement**
Pot life~~,~~ (at 75 F), minutes	10 ~~–~~to 55
Tensile S~~s~~trength~~,~~ (at 75 F, 7 ~~D~~days), psi, min.	1500
Tensile elongation~~,~~ (at 75 F), percent, min.	20
Water ~~a~~Absorption, percent, max.	0.8
Compressive S~~s~~trength~~,~~ (at 4 hr)~~,~~, psi, min.	1000
Compressive ~~s~~Strength~~,~~ (at 48 hr~~,~~ wet), psi, min.	4000
Ash ~~c~~Content, percent, max.	0.5
Rotational Viscosity~~,~~ (at 75 F, s~~S~~pindle 3, 60 rpm), ~~P~~poise	7 to~~-~~ 25
Volatile Content, percent, max.	3.0
Thermal Shear (shearing, shrinkage, expansion or scaling)	None ~~shearing, shrinkage, expansion or scaling.~~

1039.60.2.1 Classes. Epoxy resin shall be formulated for use at specific temperatures as specified in ASTM C 881. The controlling temperature shall be that of the hardened concrete surface to which the ~~overlay~~ polymer is applied. Where unusual curing rates are desired and upon the approval from the engineer, a class of epoxy resin may be used at a temperature other than that for which the epoxy resin is normally intended.

1039.60.2.2 Packaging. Containers shall be identified as "Component A--Contains Epoxy Resin" and "Component B--Contains Hardener" and shall show the type, class and mixing directions. Each container shall be marked with the name of the manufacturer, class, batch, or lot number, date of packaging, date of shelf life expiration, pigmentation, if any, manufacturer, and the quantity contained in pounds and gallons.

1039.60.3 Aggregate ~~for Epoxy Polymer Concrete Overlay~~. Aggregate shall be bauxite, crushed porphyry, aluminum oxide, flint chat or other similarly hard, durable, dry aggregates with less than 0.2 percent moisture. Aggregate shall be in accordance with the following gradation:

~~Aggregate Requirements~~	
Sieve Size	**% Passing By Weight**
~~#~~No. 4	100
~~#~~No. 20	0-5

#No. 200	0-1.0

1039.60.3.1 Lead Content. Aggregate produced as a by-product from lead or zinc mining operations shall not have a total lead content greater than 4,500 ppm, as determined by EPA Method 3050A, "Acid Digestion of Sediments, Sludges and Soils. Suppliers of this aggregate shall provide certification to the engineer for each shipment that the total lead content of the aggregate does not exceed this value, and attach a typical test report from the same source no older than 12 months prior to the shipment.

1039.60.3.2 Aggregate Recommendation. For each contract, the epoxy polymer supplier shall supply a letter to the engineer specifically recommending the use of a designated aggregate and source, which has been previously approved by Construction and Materials.

1039.60.4 Epoxy Polymer Performance ~~Overlay System~~. The ~~overlay system~~ epoxy polymer shall not exhibit shearing, shrinkage, expansion or scaling.

1039.60.5 Test Methods. Tests will be performed in accordance with the following methods:

Test Methods	
Rotational Viscosity	ASTM D 2393 Model LVT Brookfield viscometer
Epoxy ~~e~~Equivalent	MoDOT Test Method TM 73
Volatile ~~c~~Content[a] [a]	ASTM D 1259, Method B, for mixed system
Filler ~~c~~Content	MoDOT Test Method TM 73
Ash ~~c~~Content	ASTM D 482
Pot L~~l~~ife	AASHTO T 237
Tensile S~~s~~trength	ASTM D 638
Compressive ~~s~~Strength	ASTM C 881
Water A~~a~~bsorption	ASTM D 570
Thermal Shear	MoDOT Test Method TM 72

[a] Sample cured 4 days at room temperature and weighed on a previously weighed metal foil.

1039.60.6 Manufacturer and Brand Name Approval. Prior to approval and use of this material, the manufacturer shall submit to Construction and Materials a certified test report showing specific test results in accordance with all requirements of this specification. The certified test report shall include the manufacturer's name, brand name of material, lot tested, date of manufacture, ratio of components by volume and system tested. In addition, the manufacturer shall submit to Construction and Materials a sample representing the system for laboratory testing accompanied by a technical data sheet, an MSDS and any special installation instructions relative to the system being submitted. Upon approval of the certified test report and satisfactory results of tests performed on the sample submitted, the brand name and manufacturer will be placed on a qualified list of epoxy resin material for epoxy polymer ~~concrete overlay~~wearing surface. New certified test results and samples shall be submitted any time the manufacturing process or the material formulation is changed and may be required when random sampling and testing of material offered for use indicates non-conformity with any of the requirements herein specified.

1039.60.7 Product History. The ~~overlay system~~ epoxy polymer shall have a proven record of a minimum of two years on similar bridge decks within the United States. A list including the location, the name of the agency involved with the project, and a name and phone number of a contact person with that agency, shall be provided for each location used as evidence of satisfactory use.

1039.60.8 Acceptance. The manufacturer shall furnish certification to the engineer at the destination that the material supplied is in accordance with all requirements specified and stating

testing of material offered for use indicates nonconformity with any of the requirements herein specified.

1039.70.4 Acceptance. To obtain final acceptance of this material, the manufacturer shall furnish certification to the engineer at destination certifying that the material supplied is in accordance with all requirements specified and stating that the material is identically formulated to the material tested for manufacturer and brand name approval.

SECTION 1039.80 MMA POLYMER SLURRY WEARING SURFACE.

1039.80.1 Scope. This specification covers methylmethacrylate (MMA) primer, polymer slurry and top coat; and broadcast aggregate to be used for a MMA polymer slurry wearing surface.

1039.80.2 Preapproved Product. The following material has been preapproved for use under this specification: Transpo T-18 Thin Overlay and SterlingLloyd Bridgemaster.

1039.80.3 MMA Primer. The methylmethacrylate primer shall be wax-free low odor and comply with the following requirements:

Property	Requirement	Test Method
Viscosity, cps	50 to 70	ASTM D2393
Density, lb/gal	8 to 9	ASTM D2849
Pot Life (at 70 F), minutes	10 to 30	ASTM C881
Flash Point, F, min.	43	ASTM D1310
Solids Content (w/catalyst), %, min.	100	ASTM D1644

1039.80.4 MMA Polymer Slurry. The methylmethacrylate polymer slurry shall comply with the following requirements:

Property	Requirement	Test Method
Elongation at Break, percent, min.	50	ASTM D 638 (Type 1)
Tensile Strength (at 75 F), psi	500 to 900	ASTM D 638
Tensile Adhesion, psi, min.	250	ASTM C 1583
Water Absorption (at 24 hr), %, max.	0.8	ASTM D 570
Volatile Content, percent, max.	3.0	ASTM D 2369

1039.80.5 Broadcast Aggregate. Aggregate shall be in accordance with Sec 1039.60 unless otherwise specified. Unless otherwise specified, aggregate shall be light-colored (i.e. flint rock or similar).

1039.80.5.1 All aggregates shall be furnished in appropriate packaging that is clearly labeled and protects the aggregate from any contaminates on the jobsite and from exposure to rain or other moisture.

1039.80.6 MMA Top Coat. The methylmethacrylate top coat shall comply with the following requirements:

Property	Requirement	Test Method
Viscosity, cps	200 to 400	ASTM D 2393
Flash Point, F, min.	50	ASTM D 1310

SECTION 1039.90 POLYESTER POLYMER WEARING SURFACE.

1039.90.1 Scope. This specification covers methylmethacrylate primer, polyester resin binder and aggregate to be used for a Polyester Polymer Wearing Surface.

1039.90.2 Primer. The prepared surface shall receive a wax-free low odor, high molecular weight methacrylate prime coat complying with the following requirements:

Property	Requirement	Test Method
Viscosity (Brookfield RVT w/UL adapter, 50 rpm at 77 F), Pa-s, max.	0.025	ASTM D 2196[a]
Specific Gravity (at 75 F), min.	0.90	ASTM D 1475[a]
Volatile Content, %, max.	30	ASTM D 2369[a]
Flash Point, F, min.	180	ASTM D 3278[a]
Vapor Pressure (at 77 F), mm Hg, max.	1.0	ASTM D 323[a]
Tack Free Time (at 77 F), minutes, max.	400	ASTMC 679
PCC Saturated Surface-Dry Bond Strength (24 hrs at 70 F +/- 1°), psi, min.	500	California Test 551

[a]Tested prior to adding initiator

1039.90.2.1 Mixing Requirements. The prime coat initiator shall consist of a metal drier and peroxide. If supplied separately from the resin, at no time shall the metal drier be mixed directly with the peroxide.

1039.90.2.2 Storage. The containers shall be stored in a manner that will not allow leakage or spillage from one material to contact the containers or materials of the other.

1039.90.3 Aggregates. The aggregates shall comply with Sec 1005, except as specified herein.

1039.90.3.1 Crushed Particles. Aggregate retained on the No. 8 sieve shall have a maximum of 45 percent crushed particles as determined by AASHTO T 335.

1039.90.3.2 Absorption. The aggregate absorption shall not exceed one percent as determined by AASHTO T 85.

1039.90.3.3 Moisture Content. At the time of mixing with the resin, the moisture content of the aggregate, as determined by AASHTO T 255, shall not exceed one half of the aggregate absorption.

1039.90.3.4 Temperature. The aggregate temperature shall be between 45 F and 100 F at the time of mixing.

1039.90.3.5 Combined Gradation. Aggregate for polyester polymer concrete shall comply with the following requirements:

Sieve Size	1/2" Maximum % Passing by Weight	3/8" Maximum % Passing by Weight
½"	100	100
3/8"	83 – 100	100
No. 4	65 – 82	62 – 85
No. 8	45 – 64	45 – 67
No. 16	27 – 48	29 – 50
No. 30	12 – 30	16 – 36
No. 50	6 – 17	5 – 20
No. 100	0 – 7	0 – 7
No. 200	0 - 3	0 – 3

1039.90.3.6 Fine Aggregate. The fine aggregate shall consist of natural sand.

1039.90.3.7 Finishing Sand. The sand for abrasive finish shall be commercial quality blast sand having at least 95 percent passing the No. 8 sieve and at least 95 percent retained on the No. 20 sieve when tested in accordance with AASHTO T 27. The absorption of the sand shall not exceed 1 percent when tested in accordance with AASHTO T 84.

1039.90.4 Polyester Resin Binder. The resin shall be an unsaturated isophthalic-styrene co-polymer conforming to the following requirements:

Property	Requirement	Test Method
Viscosity (RVT, No. 1 Spindle, 20 rpm at 77 F), Pa-s	0.075 to 0.200	ASTM D 2196[a]
Specific Gravity (at 77 F)	1.05 to 1.10	ASTM D 1475[a]
Elongation (Type I at 0.45 inch/minute, thickness = 1/4" +/- 0.04), %, min.	35	ASTM D 638
(Sampling Condition)	18h at 77 F & 50% RH + 5h at 158 F	ASTM D 618
Tensile Strength (Type I at 0.45 inch/minute, thickness = 1/4" +/- 0.04), psi, min.	2500	ASTM D 638
(Sampling Condition)	18h at 77 F & 50% RH + 5h at 158 F	ASTM D 618
Styrene Content (by weight), %	40 to 50	ASTM D 2369[a]
Silane Coupler (by weight of polyester-styrene resin), %, min.	1.0	
PCC Saturated Surface-Dry Bond Strength (24 hrs at 70 F +/- 1 F), psi, min.	500	California Test 551

[a]Tested prior to adding initiator

1039.90.4.1 Silane Coupler. The silane coupler shall be an organsilane ester, gammamethacryloxpropyltrimethoxysilane.

1039.90.4.2 Hardener. The promoter/hardeners shall be compatible with suitable methyl ethyl ketone peroxide (MEKP) and cumene hydroperoxide (CHP) initiators. MEKP initiators shall be used when the surrounding concrete temperatures are above 60 F. A blend of initiators may be used as approved by the engineer when the surrounding concrete temperature is 50 – 60 F.