



SECTION 216

REMOVALS FOR BRIDGE STRUCTURES

SECTION 216.10 REMOVAL OF BRIDGES

216.10.1 Description. This work shall consist of removing and disposing of existing bridge structures as shown on the plans or as directed by the engineer.

216.10.2 Removal Requirements. The entire structure, including all substructure units, shall be removed to an elevation 2 feet (600 mm) below the finished ground line or streambed. Any portion of an existing structure below the ground line that interferes with the construction of the new structure shall be removed. Existing structures used for handling temporary traffic shall not be removed until the replacement structure is open to traffic. Notification of demolition shall be made in accordance with Sec 202.40.1.1.

216.10.3 Method of Measurement. No measurement will be made for removal of bridges.

216.10.4 Basis of Payment. Removal of bridges will be paid for at the contract lump sum price.

SECTION 216.20 SCARIFICATION OF BRIDGE DECKS

216.20.1 Description. This work shall consist of scarifying the bridge deck to the depth shown on the plans or as directed by the engineer.

216.20.2 Removal Requirements. The bridge deck shall be uniformly scarified to the depth as shown on the plans. Excessive tearing of the deck surface shall require immediate correction. Over areas of half-sole repair and full depth repair, the scarified removal depth may be coincidental with the repair removal operation. The scarification 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 scarifying process shall not produce a polished or slick surface. Any epoxy patches encountered shall be completely removed to sound, natural concrete.

216.20.3 Method of Measurement. Final measurement of scarification of bridge decks will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, scarification of the bridge decks will be measured to the nearest square yard (m^2) 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.

216.20.4 Basis of Payment. Scarification of bridge decks will be paid for at the contract unit price.

SECTION 216.30 SEAL COAT AND WEARING SURFACE REMOVAL

216.30.1 Description. This work shall consist of the complete removal and disposal of the unbonded seal coat, bonded seal coat, 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.

216.30.2.2 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 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.

216.30.3 Method of Measurement. Final measurement of the seal coat and 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, asphalt wearing surface and concrete wearing surface will be measured to the nearest square foot (0.1 m²) 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.

216.30.4 Basis of Payment. Seal coat and 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 will be considered completely covered in the contract unit price for other items.

SECTION 216.40 REMOVAL AND STORAGE OF EXISTING BRIDGE RAILS

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 contractor shall be responsible for damage to or loss of any part, including necessary repair or replacement, until storage has been acceptably completed.

216.40.3 Method of Measurement. Final measurement of the removal and storage of existing bridge rails will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, removal and storage of existing bridge rails will be measured to the nearest linear foot (0.5 m) from end of rail to end of rail. The revision or correction will be computed and added to or deducted from the contract quantity.

216.40.4 Basis of Payment. Removal and storage of existing bridge rails will be paid for at the contract unit price.

SECTION 216.50 REMOVAL OF EXISTING BRIDGE DECKS

216.50.1 Description. This work shall consist of removing and disposing of existing bridge rails, curbs, slab, expansion devices and any other items necessary to reconstruct the bridge deck as shown on the plans or as directed by the engineer.

216.50.2 Removal Requirements.

216.50.2.1 The existing bridge deck shall be removed by methods such that the girders, stringers or floor beams that are to remain in place are not damaged. Any damage to the girders, stringers and floor beams resulting from the contractor's operations shall be repaired or replaced as directed by the engineer, at the contractor's expense. Notification of demolition shall be made in accordance with Sec 202.40.1.1.

216.50.2.2 The top surface and the sides of the top flanges of existing steel girders, stringers and floor beams exposed by removal of the bridge deck shall be cleaned with a minimum of SSPC-SP-3 surface preparation. The area shall be coated with one coat of gray epoxy-mastic primer (non-aluminum) in accordance with Sec 1081 to produce a dry film thickness of no less than 3 mils (75 μm). The gray epoxy-mastic primer (non-aluminum) shall be compatible with concrete.

216.50.3 Method of Measurement. Final measurement of removal of the existing bridge decks will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, removal of the existing bridge decks will be measured to the nearest square foot (0.1 m^2) based on measurement longitudinally from end of slab to end of slab and transversely from out to out of the bridge deck. The revision or correction will be computed and added to or deducted from the contract quantity.

216.50.4 Basis of Payment. Removal of the existing bridge deck will be paid for at the contract unit price.

SECTION 216.60 PARTIAL REMOVAL OF EXISTING BRIDGE DECKS

216.60.1 Description. This work shall consist of removing and disposing of the existing curbs, rails, slab and any other items necessary to reconstruct the bridge deck as shown on the plans or as directed by the engineer.

216.60.2 Removal Requirements.

216.60.2.1 Concrete shall be removed by conventional hand/mechanical equipment in accordance with Sec 704. A removal line shall be established with the joint sawed to a depth of one inch (25 mm) with a vertical face. In no case shall existing reinforcement be cut or damaged by the sawing operation.

216.60.2.2 The existing reinforcing steel shall be stripped, cleaned, straightened and extended into or utilized in the new concrete as shown on the plans. Care shall be taken to prevent damage to the reinforcement or the reinforcement bond to the concrete. If any reinforcement is damaged or deteriorated, the engineer shall be notified. Cut or broken bars or bars having 10 percent or more cross sectional area lost shall be spliced 24 diameters on each side of the damage.

216.60.2.3 The existing bridge deck shall be removed by methods such that the girders, stringers and floor beams that are to remain in place are not damaged. Any damage to the girders, stringers and floor beams resulting from the contractor's operations shall be repaired or replaced as directed by the engineer at the contractor's expense.

216.60.2.4 The top surface and the sides of the top flanges of existing steel girders, stringers and floor beams exposed by removal of the bridge deck shall be cleaned with a minimum of SSPC-SP-3 surface preparation. This area shall be coated with one coat of gray epoxy-mastic primer (non-aluminum) in accordance with Sec 1081, to produce a dry film thickness of no less than 3 mils (75 μm). The gray epoxy-mastic primer (non-aluminum) shall be compatible with concrete.

216.60.3 Method of Measurement. Final measurement of the partial removal of existing bridge decks will not be made except for authorized changes during construction or where appreciable errors are found in the contact quantity. Where required, partial removal of existing bridge decks will be measured to the nearest square foot (0.1 m^2) based on measurement longitudinally from end of slab to end of slab and transversely from outside edge of the existing slab to the line shown on bridge plans. The revision or correction will be computed and added to or deducted from the contract quantity.

216.60.4 Basis of Payment. Partial removal of existing bridge decks will be paid for at the contract unit price.

SECTION 216.70 PARTIAL REMOVAL OF CULVERT AND SUBSTRUCTURE CONCRETE

216.70.1 Description. This work shall consist of removing and disposing of existing culvert wings and slab or substructure concrete as shown on the plans or as directed by the engineer.

216.70.2 Material. The qualified special mortar shall be in accordance with Sec 704.2.

216.70.3 Removal Requirements.

216.70.3.1 Any excavation required during the removal of concrete shall be backfilled after the new concrete is poured and cured. Any part of the roadway that is removed or damaged and any part of the remaining structure damaged during the removal of the existing concrete shall be repaired or the material replaced, at the contractor's expense, as directed by the engineer.

216.70.3.2 Concrete removal shall be in accordance with Sec 216.60.2.1. The concrete to be removed will not be included in the excavation volume. Areas exposed by removal of concrete and not covered by new concrete shall be coated with a qualified special mortar.

216.70.3.3 Existing reinforcing steel utilized in the new concrete shall be prepared in accordance with Sec 216.60.2.2. Existing reinforcing steel not utilized in the new concrete shall be cut off one inch (25 mm) into the concrete. Any holes outside the limits of new concrete shall be filled with a qualified special mortar.

216.70.4 Method of Measurement. No measurement will be made for partial removal of culvert and substructure concrete.

216.70.5 Basis of Payment. Partial removal of culvert and substructure concrete will be paid for at the contract lump sum price.

SECTION 216.80 CURB REMOVAL

216.80.1 Description. This work shall consist of removing and disposing of existing curbs, rails and end posts as shown on the plans or as directed by the engineer.

216.80.2 Material. Qualified special mortar shall be in accordance with Sec 704.2.

216.80.3 Removal Requirements.

216.80.3.1 Concrete removal shall be in accordance with Sec 216.60.2.1. Areas exposed by removal of concrete and not covered by new concrete shall be coated with a qualified special mortar.

216.80.3.2 Existing reinforcing steel utilized in the new concrete shall be prepared in accordance with Sec 216.60.2.2. Existing reinforcing steel not utilized in the new concrete and existing rail post bolts shall be cut off one inch (25 mm) into the concrete. Any holes outside the limits of new concrete shall be filled with a qualified special mortar.

216.80.4 Method of Measurement. Final measurement of curb removal will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, curb removal will be measured to the nearest linear foot (0.5 m) based on measurement from end of curb to end of curb. The revision or correction will be computed and added to or deducted from the contract quantity.

216.80.5 Basis of Payment. Curb removal will be paid for at the contract unit price.

SECTION 216.90 REMOVAL OF EXISTING EXPANSION JOINTS AND ADJACENT CONCRETE

216.90.1 Description. This work shall consist of any excavation, backfill, removal and disposal of the existing expansion joint system, curb plates and adjacent concrete as shown on the plans or as directed by the engineer.

216.90.2 Material. Qualified special mortar shall be in accordance with Sec 704.2.

216.90.3 Removal Requirements.

216.90.3.1 Any excavation required during the removal of concrete shall be backfilled after the new concrete is poured and cured. Any part of the roadway that is removed or damaged and any part of the remaining structure that is damaged during the removal of the existing concrete shall be repaired or the material replaced as directed by the engineer at the contractor's expense.

216.90.3.2 Concrete removal shall be in accordance with Sec 216.60.2.1. The concrete to be removed will not be included in the excavation volume. Areas exposed by removal of concrete and not covered by new concrete shall be coated with a qualified special mortar.

216.90.3.3 Existing reinforcing steel utilized in the new concrete shall be prepared in accordance with Sec 216.60.2.2. Existing reinforcing steel not utilized in the new concrete shall be cut off one inch (25 mm) into the concrete. Any holes outside the limits of new concrete shall be filled with a qualified special mortar. Any reinforcement that interferes with the installation of the new expansion joint system shall be called to the attention of the engineer and may be shifted, cut or removed as directed by the engineer. Any reinforcing steel removed that was to remain in place shall be replaced with bars of like size and shape, Grade 60 (Grade 420), in accordance with Sec 706 or Sec 710 and spliced 24 bar diameters as directed by the engineer.

216.90.4 Method of Measurement. Final measurement of the removal of existing expansion joints and adjacent concrete will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, removal of the existing expansion joint system and adjacent concrete will be measured to the

nearest linear foot (0.5 m) based on measurement from roadway face of curb to roadway face of curb along centerline of the existing joint. The revision or correction will be computed and added to or deducted from the contract quantity. Portions of the joint extending past the roadway face of curbs will not be measured for payment.

216.90.5 Basis of Payment. Removal of existing expansion joints and adjacent concrete will be paid for at the contract unit price for each of the items included in the contract.

SECTION 216.100 REMOVAL OF EXISTING EXPANSION JOINT SEAL OR SEALANT

216.100.1 Description. This work shall consist of removing and disposing of existing expansion joint seals or sealant, curb plates and any partial removal of concrete as shown on the plans or as directed by the engineer.

216.100.2 Material. Qualified special mortar shall be in accordance with Sec 704.2.

216.100.3 Removal Requirements.

216.100.3.1 Concrete removal shall be in accordance with Sec 216.60.2.1. Areas exposed by removal of concrete and not covered by new concrete shall be coated with a qualified special mortar. Any damage to the remaining structure resulting from the contractor's operations shall be repaired or replaced, at the contractor's expense, as directed by the engineer.

216.100.3.2 Existing reinforcing steel utilized in the new concrete shall be in accordance with Sec 216.60.2.2. Existing reinforcing steel not utilized in the new concrete shall be cut off one inch (25 mm) into the concrete. Any holes outside the limits of new concrete shall be filled with a qualified special mortar. Any reinforcement that interferes with the installation of the new expansion joint seal or sealant shall be called to the attention of the engineer and may be shifted, cut or removed as directed by the engineer. Any reinforcing steel removed that is to remain in place shall be replaced with bars of like size and shape being Grade 60 (Grade 420).

216.100.4 Method of Measurement. Final measurement of removal of existing expansion joint seal or sealant will not be made except for authorized changes during construction or where appreciable errors are found in the contract quantity. Where required, removal of the existing expansion joint seal and sealant will be measured to the nearest linear foot (0.5 m) based on measurement from roadway face of curb to roadway face of curb along centerline of the existing joint. The revision or correction will be computed and added to or deducted from the contract quantity. Portions of the joint extending past the roadway face of curbs will not be measured for payment.

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



SECTION 401

PLANT MIX BITUMINOUS BASE AND PAVEMENT

401.1 Description. This work shall consist of a bituminous mixture placed, spread and compacted as shown on the plans or as directed by the engineer.

401.2 Material.

401.2.1 The grade of asphalt binder will be specified in the contract. When the plasticity index on individual aggregate fractions with 10 percent or more passing the No. 30 (600 μ m) sieve exceeds 3, a moisture susceptibility test shall be required in accordance with Sec 401.4.5 during the mix design process. If the plasticity index exceeds that of the material approved for the mix design, additional testing may be required. All material shall be in accordance with Division 1000, Material Details, and specifically as follows:

Item	Section
Coarse Aggregate	1004.2
Fine Aggregate	1002.3
Mineral Filler	1002.4
Hydrated Lime	1002.5
Asphalt Binder, Performance Graded (PG)	1015

401.2.2 Recycled Asphalt Material. Recycled asphalt materials shall be in accordance with Sec 403.2 except, all RAP material shall be in accordance with Sec 1004 for deleterious and other foreign material.

401.3 Composition of Mixtures. Aggregate sources shall be from the specific ledge or combination of ledges within a quarry, or processed aggregate from a particular product, as submitted in the mix design. The total aggregate prior to mixing with asphalt binder shall be in accordance with the following gradation requirements:

Sieve Size	Percent Passing by Weight (Mass)			
	Base	BP-1	BP-2	BP-3
1 inch (25.0 mm)	100	100	100	100
3/4 inch (19.0 mm)	85-100	100	100	100
1/2 inch (12.5 mm)	60-90	85-100	95-100	100
3/8 inch (9.5 mm)	---	---	---	100
No. 4 (4.75 mm)	35-65	50-70	60-90	90-100
No. 8 (2.36 mm)	25-50	30-55	40-70	---
No. 16 (1.18 mm)	---	---	---	30-60
No. 30 (600 μ m)	10-35	10-30	15-35	---
No. 200 (75 μ m)	6-12	5-12	5-12	7-12

401.4 Job Mix Formula. At least 30 days prior to placing any mixture on the project, the contractor shall submit a mix design for verification and approval by Construction and Materials. The mixture shall be designed in accordance with Asphalt Institute Publication

MS-2, *Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types*. The mixture shall be compacted and tested at a minimum of three asphalt contents separated by a maximum of 0.5 percent in accordance with AASHTO T 245, except as herein noted. The test method shall be modified by short-term aging the specimens in accordance with AASHTO R 30. A detailed description of the mix design process shall be included with the job mix formula. Representative samples of each ingredient for the mixture shall be submitted with the mix design. Aggregate fractions shall be in accordance with the same proportions as the proposed job mix formula. A minimum of 150 pounds (68 kg) will be required for any individual fraction. The amount of each ingredient submitted shall be as follows for each mix design to be verified:

Ingredient	Minimum Amount
Aggregate	300 lbs (136 kg)
Hydrated Lime, Mineral Filler and/or Baghouse Fines	20 lbs (9 kg)
Asphalt Binder	10 gal. (38 L)

401.4.1 Mixture Design. Laboratories that participate and achieve a score of 3 or greater in the AASHTO proficiency sample program for T 11, T 27, T 84, T 85, T 166, T 209, T 308 and T 245 or T 312 will have the mixture verification process waived. The mix design shall be submitted to Construction and Materials for approval at least seven days prior to mixture production.

401.4.2 Required Information. The mix design shall include raw data from the design process and shall contain the following information:

- (a) Source, grade and specific gravity of asphalt binder.
- (b) Source, type (formation, etc.), ledge number(s) if applicable, gradation, and deleterious content of the aggregate.
- (c) Plasticity index of each aggregate fraction.
- (d) Bulk and apparent specific gravities and absorption of each aggregate fraction in accordance with AASHTO T 85 for coarse aggregate and AASHTO T 84 for fine aggregate, including all raw data.
- (e) Specific gravity of hydrated lime, mineral filler or baghouse fines, if used, in accordance with AASHTO T 100.
- (f) Percentage of each aggregate component.
- (g) Combined gradation of the job mix.
- (h) Percent of asphalt binder, by weight (mass), based on the total mixture.
- (i) Bulk specific gravity (G_{mb}) by AASHTO T 166, Method A of a laboratory compacted mixture.
- (j) Percent air voids (V_a) of the laboratory compacted specimen.
- (k) Voids in the mineral aggregate (VMA) and voids in the mineral aggregate filled with asphalt binder (VFA).

(l) Theoretical maximum specific gravity (G_{mn}) as determined by AASHTO T 209 in accordance with Sec 403.19.3 after the sample has been short-term aged in accordance with AASHTO R 30.

(m) Mixing temperature and molding temperature.

(n) Bulk specific gravity (G_{mb}) of the combined aggregate.

(o) Percent chert contained in each aggregate fraction.

(p) Baghouse fines added for design.

(i) Batch and continuous mix plants – Indicate which aggregate fraction to add baghouse percentage during production.

(ii) Drum mix plants – Provide cold feed settings with and without baghouse percentage.

401.4.3 Mixture Approval. No mixture will be accepted for use until the job mix formula for the project is approved by Construction and Materials. The job mix formula approved for each mixture shall be in effect until modified in writing by the engineer. When unsatisfactory results or other conditions occur, or should a source of material be changed, a new job mix formula may be required. In lieu of a new laboratory design, mixtures requiring adjustment beyond the limits allowed in Sec 401.8.2 may be designed in the field based on characteristics of plant-produced mixture in accordance with Sec 401 and verified by Construction and Materials, which may require new aggregate characteristics.

401.4.4 Mixture Characteristics.

401.4.4.1 Base, BP-1 and BP-2 mixtures shall have the following properties, when tested in accordance with AASHTO T 245. The number of blows with the compaction hammer shall be 35 or the number of gyrations shall be 50 with the gyratory compactor. BP-1 and BP-2 mixtures shall have between 60 and 80 percent of the VMA filled with asphalt binder.

Percent Air Voids	AASHTO T 245 Stability lb (N)	Voids in Mineral Aggregate ^a (VMA)
3.5-4.5	750 (3350)	13.0

^aBituminous base mixtures that would require 12.0 percent VMA following Asphalt Institute MS-2 will have a minimum 12.0 percent requirement.

401.4.4.2 BP-3 mixtures shall have the following properties, when tested in accordance with AASHTO T 312. The number of gyrations shall be 50 with the gyratory compactor. BP-3 mixtures shall have a minimum 75 percent of the VMA filled with asphalt binder and dust to effective binder ratio of 0.9 to 2.0.

Percent Air Voids	Voids in Mineral Aggregate (VMA)
3.5-4.5	16.0

401.4.4.3 When specified in the contract as BP-3NC, BP-3 mixtures containing limestone aggregate shall contain a minimum amount of non-carbonate aggregate as shown in the table below, or the aggregate blend shall have an acid-insoluble residue (A.I.R.), MoDOT Test

Method TM 76, meeting the criteria of crushed non-carbonate material. The A.I.R. shall be determined on the minus No. 4 (4.75 mm) sieve. Non-carbonate aggregate shall have an A.I.R. of at least 85 percent insoluble residue.

Aggregate	Minimum Non-Carbonate by Volume
Limestone	20% Minus No. 4
Dolomite	No Requirement

401.4.5 Moisture Susceptibility. Moisture susceptibility may be tested in accordance with AASHTO T 283. A minimum retained strength of 70 percent shall be obtained when tested for moisture susceptibility. An approved anti-strip additive may be added to increase retained strength to a passing level. When testing is required by Sec 401.2.1, the mixture shall be testing during production in accordance with Sec 403.19.

401.4.6 Time Limit. A mix design may be transferred to other projects for a period of three years from the original approval date provided satisfactory results are obtained during production and placement.

401.5 Gradation and Deleterious Content Control. In producing mixtures for the project, the plant shall be operated such that no intentional deviations from the job-mix formula are made. The contractor shall determine on a daily basis at minimum, the gradation on the aggregate reclaimed from the RAP by either extraction or binder ignition. The gradation results shall be used to determine the daily specification compliance for the combined gradation. Mixtures as produced shall be subject to the following tolerances and controls:

(a) The maximum variations from the approved job-mix formula shall be within the following tolerances:

Passing No. 8 (2.36 mm) sieve ^a	± 5.0 percentage points
Passing No. 200 (75 µm) sieve	± 2.0 percentage points

^aUse No. 16 (1.18 mm) sieve for BP-3

(b) The deleterious content of the material retained on the No. 4 (4.75 mm) sieve shall not exceed the limits specified in Sec 1004.2.

(c) If the plasticity index of any fraction exceeds that of the material approved for the mix design, additional testing may be required.

(d) The quantity of asphalt binder introduced into the mixer shall be the quantity specified in the job-mix formula. No changes shall be made to the quantity of asphalt binder without written approval from the engineer. The quantity of asphalt binder determined by tests on the final mixture shall not vary by more than ± 0.5 percent from the job-mix formula.

401.5.1 Sample Location. The gradations of the total aggregate will be determined from samples taken from the hot bins on batch-type plants or continuous mixing plants or from the composite cold feed belt on drum mix plants. The deleterious content of the total aggregate shall be determined from samples taken from the composite cold feed belt. When required, samples for plasticity index shall be taken from the stockpile. The RAP shall be sampled from the RAP feeding system on the asphalt plant. Samples for asphalt content determination may be taken at the plant.

401.5.2 Substitutions. At the option of the contractor and at no cost to the Commission, the contractor may use a mixture with smaller size aggregate or an approved Sec 403 mixture,

design level C or, E, with the same or smaller size aggregate in lieu of any Sec 401 mixture. When this substitution is made, the layer thickness and density requirements in Sec 401 will apply.

401.5.3 Commercial Mixture. If specified in the contract that an approved commercial mixture may be used, the contractor shall, at least seven days prior to the desired time of use, furnish a statement setting out the source and characteristics of the mixture proposed to be furnished. The statement shall include:

(a) The types and sources of aggregate, percentage range of each, and range of combined gradation.

(b) The percent and grade of asphalt binder.

(c) The mixing time and range of mixture temperature.

The plant shall be designed and operated to produce a uniform, thoroughly mixed material free from segregation. It will not be necessary for the plant to meet the requirements of Sec 404. A field laboratory will not be required. If the proposed mixture and plant are approved by the engineer, the component material and the mixture delivered will be accepted or rejected by visual inspection. The supplier shall furnish with the first truckload of each day's production, a certification that the material and mixture delivered are in conformance with the approved mixture. Upon completion of the work, a plant certification shall be furnished by the supplier for the total quantity delivered. The mixture shall be transported, placed and compacted in accordance with Sec 401.7. Without specific contract designation, an approved commercial mixture may be used in lieu of plant mix bituminous pavement or base course mixtures for work that is considered temporary construction and is to be maintained at the contractor's expense. Temporary construction will be defined as work that is to be removed prior to completion of the contract.

401.5.4 Moisture Content. The bituminous mixture, when sampled and tested in accordance with MoDOT Test Method TM 53, shall contain no more than 0.5 percent moisture by weight (mass) of the mixture.

401.5.5 Contamination. The bituminous mixture shall not be contaminated with deleterious agents such as unburned fuel, objectionable fuel residue or any other material not inherent in the job mix formula.

401.6 Field Laboratory. The contractor shall provide a Type 3 field laboratory in accordance with Sec 601. The contractor may use the equipment provided in the Type 3 laboratory as long as adequate space is provided for the engineer's work.

401.7 Construction Requirements.

401.7.1 Weather Limitations. Bituminous mixtures shall not be placed on any wet surface or frozen pavement. Temperatures shall be obtained in accordance with MoDOT Test Method TM 20.

401.7.2 Bituminous Mixing Plants. Bituminous mixing plants and preparation of material and mixtures shall be in accordance with Sec 404.

401.7.3 Subgrade Preparation. The subgrade upon which the bituminous mixture is to be placed shall be prepared in accordance with Sec 209 and tacked or primed, as specified in the contract, in accordance with Secs 407 and 408, as applicable. For base widening work, the bottom of the trench shall be compacted until further consolidation is not visually evident, by

use of a trench roller having a weight (mass) of no less than 300 psi (5.5 kg/mm) of width of rear roller, or by mechanical tampers or other methods approved by the engineer. Suitable excavated material may be used in shouldering operations. On the outside of curves, the design depth of trench at the beginning of the superelevation transition shall be varied gradually to the minimum depth at the end of the superelevation transition. Slight transitioning of the width of the base widening will be necessary to permit the indicated angle of repose or shear angle outside of the ultimate edge of surface. The bottom of the trench shall in no case be less than 3 inches (75 mm) below the surface of the existing pavement. All surplus excavated material shall be disposed of by the contractor in areas to be secured by the contractor beyond the right of way limits. An acceptable written agreement with the property owner on whose property the material is placed shall be submitted to the engineer.

401.7.4 Hauling Equipment. Trucks used for hauling bituminous mixtures shall be in accordance with Sec 404.

401.7.5 Spreading. The base course, primed surface, or preceding course or layer shall be cleaned of all dirt, packed soil or any other foreign matter prior to spreading the bituminous mixture. The mixture shall be spread in the number of layers and in the quantity required to obtain the compacted thickness and cross section shown on the plans. When placing multiple layers with varying thicknesses, the thicker layer shall be placed first. The compacted thickness of a single layer of bituminous pavement mixture shall be no more than 2 inches (50 mm) for the surface course and 4 inches (100 mm) for the leveling course.

401.7.5.1 Irregularities. The mixture shall be spread without tearing the surface and struck off such that the surface is smooth and true to cross section, free from all irregularities, and of uniform density throughout. Care shall be used in handling the mixture to avoid segregation. Areas of segregated mixture shall be removed and replaced with a suitable mixture at the contractor's expense. The outside edge alignment shall be uniform. Irregularities shall be corrected by adding or removing mixture before compacting. In situations where there is a dispute in the existence of segregation, the area in question will be tested in accordance with MoDOT Test Method TM 75. Mixture production shall immediately cease if either criteria of MoDOT Test Method TM 75 fail. Segregated mixtures shall be removed and replaced to the limits determined by the engineer.

401.7.5.2 Leveling Course. If required by the contract, a leveling course consisting of a layer of variable thickness shall be spread to the desired grade and cross section to eliminate irregularities in the existing surface. Spot-leveling operations over small areas, with feathering at high points and ends of spot areas, may be required prior to placing the leveling course. Rigid control of the placement thickness of the leveling course will be required. The mixture shall be practically free from segregation.

401.7.5.3 Base Widening. The specified total thickness of base widening shall be completed to the adjacent traveled way elevation as shown on the plans. Additional thickness of base widening may be placed as required prior to coldmilling, at the contractor's expense, and shall subsequently be coldmilled to the same elevation as the traveled way, if conducive to expedite operations. On base-widening work, a succeeding layer of bituminous mixture may be placed the same day as the previous layer, if it can be shown that the desired results are being obtained. On small areas, and on areas that are inaccessible to mechanical spreading and finishing equipment, the mixture may be spread and finished by hand methods if permitted by the engineer. At least one lane of the existing pavement and the adjacent shoulder shall be kept open to traffic at all times during construction, except for short intervals when the movement of the contractor's equipment will seriously hinder the flow of traffic. Intervals during which the contractor will be allowed to halt traffic shall be as designated by the engineer. The contractor shall not open more trench ahead of the first layer of the base widening than is necessary for placing that layer in one half a day's operations. The first layer

of the base widening shall not be placed for a greater distance ahead of the second layer than is necessary for placing the second layer in one half a day's operations. The second layer shall not be placed for a greater distance ahead of the final layer than is necessary for placing the final layer in one day's operation. Any changes in these lengths shall be made only with written permission from the engineer.

401.7.5.4 Edge Differential. For roadways constructed under traffic, no pavement edge differential shall be left in place for more than seven days, unless approved by the engineer.

401.7.6 Joints. The minimum density of all traveled way pavement within 6 inches (150 mm) of a longitudinal joint, including the pavement on the traveled way side of the shoulder joint, shall be no less than 2.0 percent below the specified density. Once an established procedure has been demonstrated to provide the required density for longitudinal joints, at the engineer's discretion, the procedure may be used in lieu of density tests provided no changes in the material, typical location or temperatures are made. Pay adjustments due to longitudinal joint density shall apply to the full width of the lane paved. Adjustments due to joint density shall apply to the day's production from which the cores are obtained. Transverse joints shall be formed by cutting back on the previous run to expose the full depth of the layer. When a transverse vertical edge is to be left in place and opened to traffic, a temporary depth transition shall be constructed as approved by the engineer. The longitudinal joints in one layer shall offset those in the layer immediately below by approximately 6 inches (150 mm). The joints in the final surface layer shall be at the lane lines of the traveled way, except that the placement width shall be adjusted such that pavement marking shall not fall on a longitudinal joint. Each side of the joint shall be flush and along true lines.

401.7.7 Surfaced Approaches. At locations designated in the contract or as specified by the engineer, approaches shall be primed in accordance with Sec 408 and surfaced with a plant mix bituminous mixture. The bituminous surface shall be placed as shown on the plans or as directed by the engineer. Approaches shall not be surfaced before the surface course adjacent to the entrance is completed. No direct payment will be made for any work required to condition and prepare the subgrade on the approaches.

401.7.8 Compaction. The compacted mixture shall have a minimum density of 92 percent of the theoretical maximum specific gravity. Density will be determined by the direct transmission nuclear method in accordance with MoDOT Test Method TM 41 or by a specific gravity method. When the contractor elects to place a lift of mixture greater than six times the nominal maximum aggregate size, cores shall be cut in half and the density of each half determined separately. In lieu of density requirements, mixtures used for wedging, transitions, shoulders, temporary bypasses to be maintained at the expense of the contractor, and areas where a commercial mixture is used shall be thoroughly compacted by at least three complete coverages over the entire area with either a pneumatic tire roller weighing (having a mass of) no less than 10 tons (9 Mg), a tandem-type steel wheel roller weighing (having a mass of) no less than 10 tons (9 Mg) or an approved vibratory roller. Rolling shall be performed at proper time intervals on each layer and shall be continued until there is no visible evidence of further consolidation.

401.8 Quality Control. The contractor shall maintain equipment and qualified personnel to perform QC field inspection, sampling and testing in accordance with applicable portions of Sec 403. A QC Plan will not be required. A proposed third party for dispute resolution shall be included with the mix design submittal.

401.8.1 Mixture Testing. The contractor shall test the mixture at least once every 1000 tons (1000 Mg) of production or a minimum of once per day for the gradation, deleterious content, and the asphalt content. If RAP is used and AASHTO T 308 is used to determine the asphalt content, the binder ignition oven shall be calibrated in accordance with MoDOT Test Method

TM 77. At the engineer's discretion, testing may be waived when production does not exceed 200 tons (200 Mg) per day. The contractor shall certify the proper proportions of a previously proven mixture were used.

401.8.2 Failing Test. If a gradation, deleterious content, or asphalt content test result falls outside of the specification tolerances, a review or adjustment of the plant settings and production shall be made and another sample shall be immediately taken. If the second test falls outside of the specification tolerances, production shall be immediately ceased until the mixture can be brought back into specification.

401.8.3 Retained Samples. One half of the contractor's sample for gradation, deleterious content, plasticity index, and asphalt content and all cores shall be retained for the engineer. The contractor shall retain the samples for 7 days after testing has been completed and the results accepted by the engineer.

401.8.4 Pavement Testing. During construction, the engineer will designate as many tests as necessary to ensure that the course is being constructed of proper thickness, composition and density. Density of the roadway shall be determined by a daily sample consisting of four cores obtained by the contractor at stratified random locations selected by the engineer. A joint density sample shall consist of four cores taken from alternating sides of the lane placed at random locations selected by the engineer. The maximum theoretical density shown on the job mix formula shall be used for this determination. Samples, minimum 4-inch (100 mm) diameter cores, shall be taken the full depth of the layer to be tested. The contractor shall restore the surface from which samples have been taken immediately with the mixture under production or with a cold patch mixture acceptable to the engineer.

401.8.5 Density Adjustment. Payment for mixture placed at or below the required minimum density will be adjusted as follows:

Field Density Percent of Maximum Theoretical Density	Percent of Contract Unit Price ^a
91.5 or above	100%
91.0 to 91.4, inclusive	97%
90.5 to 90.9, inclusive	94%
90.0 to 90.4, inclusive	90%
89.5 to 89.9, inclusive	80%
Below 89.5	Remove and Replace

^aWhen adjustments are necessary, the lower percent of the contract unit price of either the pavement or joint density adjustment will apply.

401.9 Quality Assurance. Acceptance tests will be performed by the engineer at a rate of one independent sample per day when production exceeds 500 tons (500 Mg) per day. A favorable comparison will be considered when a QA test is within the specification tolerances. At least once for every five days of production, a split of the contractor's sample will be tested. If the results of the split sample are not within five percent on all sieves above the No. 200 (75µm), two percent on the No. 200 (75µm), within the specification ranges on the deleterious content, within two percentage points on the plasticity index, and within 0.5 percent on the asphalt content from the contractor's results, another split sample will be taken jointly with the contractor and tested. If the second test results do not compare within the specification tolerances, production shall cease until the discrepancy is resolved. If the second test results compare within the above tolerances, production may continue. Results of QA testing will be furnished to the contractor within 24 hours of obtaining the sample.

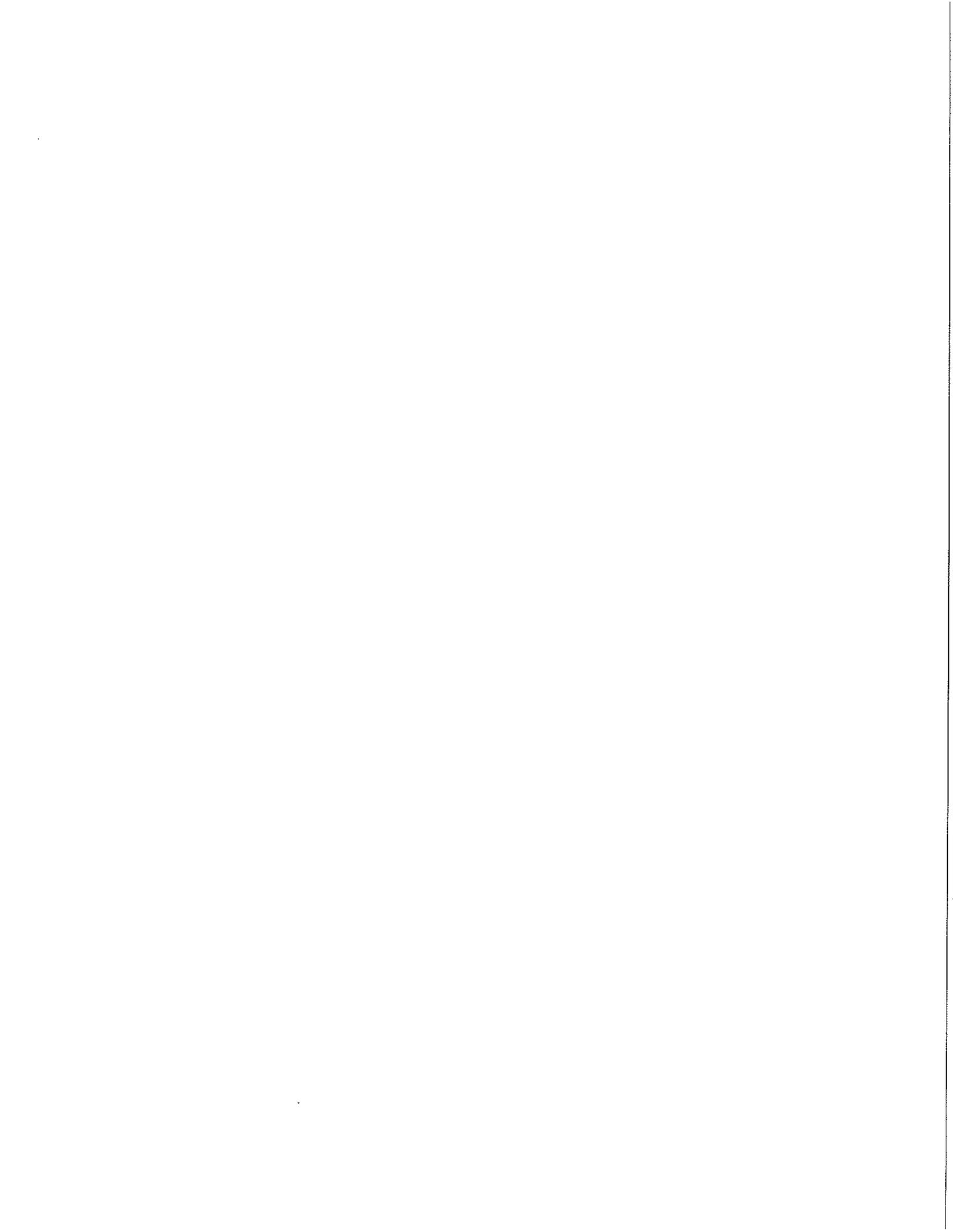
401.10 Surface Tolerance. The finished layers shall be substantially free from waves or irregularities and shall be true to the established crown and grade. At transverse construction joints, the surface of all layers shall not vary from a 10-foot (3 m) straightedge applied parallel to the center line, by more than 1/4 inch (6 mm), except that the entire surface of the final layer of plant mix bituminous base, when this layer is used as the final riding surface course, or bituminous pavement mixture, shall not vary from the 10-foot (3 m) straightedge by more than 1/8 inch (3 mm). Areas exceeding this tolerance shall be re-rolled, replaced or otherwise corrected in a manner satisfactory to the engineer.

401.11 Defective Mixture. Any mixture showing an excess of bituminous material or that becomes loose and broken, mixed with dirt, or is in any way defective, shall be removed and replaced with a satisfactory mixture, which shall be immediately compacted to conform with the surrounding area.

401.12 Pavement Marking. If the contractor's work has obliterated existing pavement marking on resurfacing projects open to through traffic, the pavement marking shall be replaced at the contractor's expense in accordance with Sec 620.

401.13 Method of Measurement. Measurement will be in accordance with Sec 403.

401.14 Basis of Payment. The accepted quantities of plant mix bituminous pavement and base course will be paid for at the contract unit price for each of the pay items included in the contract. Payment for obtaining and delivering samples of compacted mixture from the base and replacement of the surface will be made per sample at the fixed contract unit price specified in Sec 109. No direct payment will be made for excavating the trench for base widening, or for hauling and disposing of excess excavation material.





SECTION 501

CONCRETE

501.1 Description. Concrete shall consist of a mixture of cement, fine aggregate, coarse aggregate and water, combined in the proportions specified for the various classes. Admixtures may be added as specifically required or permitted.

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

Item	Section
Coarse Aggregate ^a	1005.2
Fine Aggregate ^a	1005.3
Ground Granulated Blast Furnace Slag	1017
Fly Ash	1018
Cement	1019
Concrete Admixture	1054
Concrete Tinting Material	1056
Water	1070

^aRegardless of the gradation of the coarse and fine aggregate used in concrete for pavement or base, the aggregate shall meet the quality requirements of coarse and fine aggregate for concrete pavement.

501.2.1 Aggregate Acceptance. Aggregate for Portland cement concrete masonry will be sampled and tested by the engineer in accordance with the following table at the last possible point of incorporation into the project.

Item	Property	Minimum Number of Tests
Portland Cement Concrete Masonry	Gradation of Coarse Aggregate - AASHTO T 27 and T 11	One per 500 cubic yards per fraction per project. None if less than 100 cubic yards.
	Gradation of Fine Aggregate - AASHTO T 27 and T 11	
	Deleterious Content - MoDOT Test Method TM 71	
	Absorption of Coarse Aggregate - AASHTO T 85	
	Thin or Elongated Pieces - ASTM D 4791 (+3/4 in., 5:1)	One per project.

501.2.2 Retained Samples. The engineer shall retain the portion of the sample not tested after reducing the original sample to testing size. Approximately twenty percent of the retained samples will be sent to the Central Laboratory for comparison purposes.

501.3 Mix Design. The proportions of cement, fine aggregate and coarse aggregate for concrete shall be approved by the engineer within the applicable limits of the specifications for the class of concrete specified in the contract. The contractor shall submit a mixture designed by absolute volume methods or an optimized mix design method such as Shilstone method or other recognized optimization method. Optimized will refer to aggregate gradations that produce lower water demands, as well as improved workability and finishing characteristics. The target and allowable gradation range of each fraction shall be included. The contractor

may be required to submit representative samples of each ingredient to Construction and Materials for laboratory testing.

501.3.1 Required Information. The concrete mix design shall contain the following information:

- (a) Source, type and specific gravity of Portland cement
- (b) Source, type (class, grade, etc.) and specific gravity of supplementary materials, if used
- (c) Source, name, type and amount of admixtures
- (d) Source, type (formation, etc.), ledge number if applicable, and gradation of the aggregate
- (e) Specific gravity and absorption of each fraction in accordance with AASHTO T 85 for coarse aggregate and AASHTO T 84 for fine aggregate, including raw data
- (f) Unit Weight of each fraction in accordance with AASHTO T 19
- (g) The percent of each aggregate component used for optimized concrete mixes
- (h) The design air content and slump
- (i) Batch weights of Portland Cement and supplemental cementitious materials
- (j) Batch weights of coarse, intermediate and fine aggregates
- (k) Batch weight of water

501.3.2 Paving Concrete. For PCCP mixes, the gradation requirements of Sec 1005 will not apply. For all fractions, 100 percent of each fraction shall pass the 2-inch (50 mm) sieve. When Grade F is required, 100 percent of each fraction shall pass the 3/4-inch (19.0 mm) sieve.

501.3.3 Optimized Masonry Concrete. For optimized PCCM mixes, the gradation requirements of Sec 1005.2 and Sec 1005.3 will not apply. For coarse aggregate, 100 percent of each fraction shall pass the one-inch (25 mm) sieve and no more than 2.5 percent shall pass the No. 200 (75 μ m) sieve. For fine aggregate, no more than 2.0 percent shall pass the No. 200 (75 μ m) sieve for natural sand, and no more than 4.0 percent shall pass the No. 200 (75 μ m) sieve for manufactured sand.

501.3.4 Non-Optimized Masonry Concrete. When optimized aggregate gradations are not selected by the contractor, all provisions, including gradations requirements of Sec 105 shall apply

501.3.5 Fine Aggregate Classes. Fine aggregates are grouped into four classes and a minimum cement factor has been established for each class.

501.3.6. Cement Factors. The minimum cement requirements in pounds per cubic yard (kg/m^3) of concrete for the various classes of sand shall be as follows:

Cement Requirements ^{a,b}							
Class of Sand	Class A-1 Concrete	Class B Concrete	Class B-1 Concrete	Class B-2 Concrete	Class MB-2 Concrete ^{g,h}	Pavement Concrete	Seal Concrete
A ^c	600(360)	525(310)	610(360)	705(420)	600(360)	560(330)	660(390)
B ^d	640(380)	565(330)	640(380)	735(430)	620(370)	560(330)	695(410)
C ^e	--	585(350)	660(390)	750(450)	640(380)	560(330)	715(420)
D ^f	--	620(370)	695(410)	790(470)	660(390)	560(330)	735(430)

^aWhen used, Type IP, I(PM), IS or I(SM) cement shall be substituted on a pound for pound (kg for kg) basis for Type I or Type II cement and adjustments in design mix proportions will be required to correct the volume yield of the mixture.

^bThe contractor may submit an optimized mix design which has a maximum 50 pounds per cubic yard (30 kg/m³) reduction in cement from that shown in the tables. If the contractor chooses this option, the mixture will be subject to review, laboratory testing and approval by the engineer. All other requirements for the cement factor will apply.

^cClass A sand will include all sand, except manufactured sand, weighing 109 pounds per cubic foot (having a mass of 1740 kg/m³) or more.

^dClass B sand will include all chert, river and Crowley Ridge sand weighing from 106 to 108 pounds, inclusive, per cubic foot (having a mass of 1610 - 1730 kg/m³ inclusive) or glacial sand weighing 108 pounds or less per cubic foot (having a mass of 1730 kg/m³ or less).

^eClass C sand will include all chert, river and Crowley Ridge sand weighing from 101 to 105 pounds, inclusive, per cubic foot (having a mass of 1610 - 1680 kg/m³, inclusive).

^fClass D sand will include all sand weighing 100 pounds or less per cubic foot (having a mass of 1600 kg/m³ or less) and any manufactured sand that is produced by the process of grinding and pulverizing large particles of aggregate or which contains more than 50 percent of material produced by the reduction of coarser particles. Manufactured sand produced from limestone or dolomite shall not be used in Portland cement concrete for driving surfaces such as bridge decks, pavements and shoulders.

^gModified B-2 (MB-2) concrete may be used in-place of Class B-2 Concrete.

^hModified B-2 (MB-2) concrete shall use at least one supplementary cementitious material in accordance with this specification. In no case shall MB-2 concrete use less than 15 percent fly ash or GGBFS when used as the individual supplementary cementitious material. In no case shall MB-2 concrete use less than 6 percent metakaolin when used as the individual supplementary cementitious material.

501.3.7 Unit Weight. The weight per cubic foot (mass/m³) shall be the dry rodded weight per cubic foot (mass/m³) of the aggregate, determined in accordance with AASHTO T 19.

501.3.8 Compressive Strength Requirements. Concrete classes shall meet the following compressive strength requirements in pounds per square inch (MPa):

Minimum Design Compressive Strength ¹						
Class A-1 Concrete	Class B Concrete	Class B-1 Concrete	Class B-2 Concrete	Class MB-2 Concrete	Pavement Concrete	Seal Concrete
6,000 (42)	3,000 (21)	4,000 (28)	4,000 (28)	4,000 (28)	4,000 (28)	3,000 (21)

¹Minimum compressive strength required unless otherwise specified in the contract documents or approved by the engineer.

501.4 Sampling. Sampling of fresh concrete shall be in accordance with AASHTO T 141, except that for central or truck mixed concrete, the entire sample for slump and air tests and for molding compressive strength specimens may be taken at one time after approximately one

cubic yard (m³) of concrete has been discharged, instead of at three or more regular intervals during the discharge of the entire batch. Acceptability of the concrete for slump and air content and, if applicable, for strength requirements, will be determined by tests on these samples.

501.5 Consistency. The slump of the concrete shall be within the limits for the respective classes of concrete. The concrete shall be uniform in consistency and shall contain the minimum quantity of water required to produce the designated slump. The slump of concrete mixes will be determined in accordance with AASHTO T 119. The quantity of mixing water in the concrete shall be considered the net quantity after proper allowance has been made for absorption by the aggregate. The slump and mixing water content of the concrete, when placed in the work, shall not exceed the following limits:

Slump and Maximum Water/Cementitious Materials Ratio			
Class of Concrete	Max. Slump, In. (mm)	Max. Pounds of Mixing Water Per Pound of Cementitious Materials	
		(Max. Kilograms of Mixing Water Per Kilogram of Cement)	
		Air-Entrained	Non-Air-Entrained
A-1	3 1/2 (90)	0.46	0.51
B	4 (100)	0.51	0.55
B-1	4 (100)	0.44	0.53
B-2	3 (75)	0.40	----
MB-2	6 (150)	0.42	----
Pavement	----	0.50	0.53
Seal	8 (200)	----	0.53

501.6 Measurement of Material. The cement and aggregate for concrete shall be measured by weight (mass). The weights (masses) of coarse and fine aggregates to be used will be calculated from the proportions approved by the engineer. Batches that do not contain the proper quantities of material shall be wasted at the contractor's expense.

501.6.1 Weighing Tolerances. The weighing (mass determination) and batching equipment shall be designed and maintained in such a condition that the material for each batch can be quickly and accurately weighed (determined) and shall be operated within a tolerance of plus or minus 0.5 percent for cement and plus or minus 1.0 percent for aggregate. The equipment used for delivery of material to the weigh hoppers shall not permit intermingling of material. Weighing hoppers shall discharge completely and there shall be no accumulation of tare material. Scales shall be accurate to within 0.4 percent of the net load applied. The change in load required to change the position of rest of the indicating element or elements of indicating scales an observable amount shall not be greater than 0.1 percent of the nominal scale capacity. If beam-type scales are used, a separate beam shall be provided for each type of material to be used and means shall be provided for adjustment of tare on a scale separate from those used for other material.

501.6.2 Water Meter Tolerances. Mixing water shall be measured by volume or by weight (mass). If measured by weight (mass), scales shall be in accordance with Sec 501.6.1. The device for the measurement shall be readily adjustable and under all operating conditions shall measure the required quantity within a tolerance of one quart (one liter) or one percent, whichever is greater.

501.6.3 Calibration Frequency. Plant scales and water metering devices shall be calibrated and certified by an approved commercial scale service. A copy of the certification and calibration shall be provided to the engineer upon request. Plants shall be calibrated and certified annually, and whenever plants are moved or found to be out of tolerance during

verification. Scales and water metering devices shall be verified by the contractor in the presence of the engineer every 30 working days.

501.7 Mixing. The mixer shall produce concrete uniform in color, appearance and distribution of the material throughout the mixture. The cement, aggregate and no less than 60 percent of the water shall be mixed a minimum of one minute. The remaining water shall be added within 15 seconds after all other material for the batch is in the mixer. If mixers having multiple compartment drums are used, the time required to transfer material between compartments will be considered mixing time. The speed at which the drum rotates shall be as designated by the manufacturer. If such mixing does not result in uniform and smooth texture concrete, a sufficient number of additional revolutions at the same speed shall be performed until a thorough mixing of each batch of concrete is secured. The mixing time shall be measured from the time all cement, aggregate and 60 percent of the water are in the drum. The volume of concrete mixed in each batch shall not exceed the manufacturer's rated capacity. The mixer shall be equipped to automatically time the mixing of each batch of concrete. If the automatic timing device becomes inoperable, a manual timing device shall be provided to complete the day's operation.

501.8 Central and Truck Mixed Concrete. The following additional requirements will apply to central and truck mixed concrete.

501.8.1 Mixer Inspection. All central mixers, truck mixers and agitators shall be in accordance with these specifications prior to use, and inspection of the equipment shall be made periodically during the work. Only equipment found acceptable in every respect and capable of producing uniform results will be permitted.

501.8.2 Uniformity Testing. Central mixed concrete shall be mixed in a stationary mixer. Except as otherwise permitted in accordance with Sec 501.8.9, the concrete shall be transported to the point of delivery in a truck mixer operating at agitating speed or in an agitator truck. The mixing time shall be in accordance with Sec 501.7, and as necessary to produce concrete that meets the uniformity criteria when tested in accordance with Section 10.3 of ASTM C 94, with the following additions and exceptions:

(a) the two samples shall be obtained within an elapsed time of no more than 15 minutes.

(b) The air content, slump and mix proportions of the concrete tested shall be in accordance with these specifications for that class of concrete or the uniformity tests shall be invalid.

(c) The use of a one-quarter cubic foot (0.007 m³) measure will be permitted in determination of weight per cubic foot (mass/m³).

(d) Cylinders may be cured in damp sand after the first 48 hours.

(e) The contractor may designate the mixing time for which uniformity tests are to be performed. The mixing time shall be a minimum of 60 seconds. The maximum mixing time shall not exceed the mixing time established by uniformity tests by more than 60 seconds for air-entrained concrete. The mixed concrete shall meet the uniformity requirements specified above before any concrete may be used for pavement or structures. The engineer may allow the use of the test concrete for appropriate incidental construction. Tests shall be performed by the contractor, in the presence of the engineer. No direct payment will be made for labor, equipment, material or testing. After operational procedures of batching and mixing are thus established, no changes in procedure will be permitted without re-establishing procedures by uniformity tests.

501.8.2.1 Measuring Mixing Time. Measurement of mixing time shall start at the time all the solid material is in the drum and shall end at the beginning of the next sequential operation.

501.8.2.2 Verification of Mixer. Mixer performance tests shall be repeated whenever the appearance of the concrete or the coarse aggregate content of samples selected in accordance with ASTM C 94, as modified above, indicates that adequate mixing is not being accomplished.

501.8.3 Truck Mixed Concrete. Truck mixed concrete shall be mixed at the proportioning plant and the mixer shall operate at agitating speed while in transit. Truck mixed concrete may be mixed at the point of delivery, provided the cement or cement and mixing water, are added at that point. Mixing of truck mixed concrete shall begin immediately after the introduction of the mixing water and cement to the aggregate or the introduction of the cement to the aggregate.

501.8.4 Truck Mixer Requirements. A truck mixer shall consist of a watertight revolving drum suitably mounted, fitted with adequate blades, and equipped with a device for determining the number of mixing revolutions. Truck mixers shall produce a thoroughly mixed and uniform mass of concrete and shall discharge the concrete without segregation. A truck agitator shall consist of a watertight revolving drum or a watertight container suitably mounted and fitted with adequate revolving blades. Truck agitators shall transport and discharge the concrete without segregation. Mixers and agitators shall be cleaned of accumulation of hardened concrete or mortar.

501.8.5 Rating Plate. Except as hereinafter permitted, each truck mixer shall have permanently attached to the truck a metal rating plate issued by and in accordance with the capacity requirements of the Truck Mixer Manufacturers Bureau (TMMB), as approved by NRMCA, on which is stated the maximum capacity in terms of volume of mixed concrete for the various uses to which the equipment is applicable. The truck shall also have attached a manufacturer's data plate that shall state the actual capacity as an agitator, and the maximum and minimum mixing and agitating speeds. If truck mixers are used for mixing or agitating, the volume of concrete in each batch shall not exceed the maximum capacity shown on the metal rating plate issued by the TMMB, as approved by NRMCA, except that if a lower capacity for agitating is shown on the manufacturer's data plate, that lower capacity shall govern. The minimum batch size for truck mixers shall be one cubic yard (m^3). The engineer may reduce the batch size or reject use of any truck mixer that does not produce concrete uniform in color, appearance and distribution of material throughout the mass. A quantity of concrete that results in axle and gross loads in excess of statutory limits will not be permitted.

501.8.6 Truck Mixing Requirements. Truck mixers and agitators shall be operated at the speed of rotation designated by the manufacturer of the equipment. Truck mixed concrete shall initially be mixed no less than 70 or more than 100 revolutions of the drum at mixing speed after all ingredients, including water, are in the mixer, except that when the batch volume does not exceed 57.5 percent of the gross volume of the drum or 91 percent of the rated maximum capacity, the number of revolutions required for mixing shall be no less than 50 or more than 100. When a truck mixer or truck agitator is used for transporting concrete that has been completely mixed, agitation of the concrete shall continue during transportation at the speed designated by the manufacturer of the equipment as agitating speed. Water may be added to the mixture no more than two times after initial mixing is completed. Each time water is added, the drum shall be turned an additional 30 revolutions, or more if necessary, at mixing speed, until uniform mixing is accomplished. All water added will be included in determining the effective water in the mixture.

501.8.7 Water Adjustments at Job Site. Each increment of water added at the job site shall be measured within a tolerance of one percent of the total effective water required for the batch. Water used to wash the drum of the mixer shall not be used as mixing water.

501.8.8 Handling and Discharge Requirements. Central or truck mixed concrete shall be delivered to the site of the work and shall meet the following conditions:

(a) The handling and discharge of concrete shall not cause segregation or damage to the concrete and will allow placement with a minimum of handling. All handling and discharge shall occur prior to initial set of the concrete.

(b) Truck mixed concrete shall not exceed 300 revolutions after the beginning of mixing.

501.8.9 Non-Agitating Equipment. The discharge of concrete transported in non-agitating equipment shall not cause segregation or damage to the concrete and will allow placement with a minimum of handling. All handling and discharge shall occur prior to initial set of the concrete. Bodies of non-agitating hauling equipment shall be smooth, mortar-tight metal containers capable of discharging the concrete at a satisfactory, controlled rate without segregation.

501.8.10 Testing Facilities. Proper facilities shall be provided for the engineer to inspect ingredients and processes used in the manufacture and delivery of the concrete. A Type 1 field laboratory in accordance with Sec 601 shall be provided at the proportioning plant. Facilities for obtaining representative samples of each fraction of aggregate, cement and each admixture just prior to incorporation into the mix shall be provided by the producer. Aggregate samples may be taken either by sampling the flowing aggregate stream or by belt sampling. The producer shall furnish the necessary equipment and personnel to assist the engineer in obtaining a representative sample.

501.8.11 Delivery Tickets. The manufacturer of truck mixed concrete and of central mixed concrete for use in structures shall furnish to the engineer with each truck load of concrete before unloading at the site, a delivery ticket on which is shown information concerning the concrete as follows:

- (a) Name of concrete plant.
- (b) Serial number of the ticket.
- (c) Truck number when a truck mixer is utilized.
- (d) Name of contractor.
- (e) Job Number, route and county designation.
- (f) Specific class of concrete.
- (g) Quantity of concrete in cubic yards (m^3).
- (h) Date and time when batch was loaded or of first mixing of cement and aggregate.
- (i) Number of revolutions, when truck mixed.

501.9 Volumetric Batched and Continuous Mixed Concrete. Upon written request by the contractor, the engineer may approve the use of concrete proportioned by volume. If concrete is proportioned by volume, the other requirements of these specifications with the following modifications will apply.

501.9.1 Proportional Devices. Volume proportioning devices, such as counters, calibrated gate openings or flow meters, shall be available for controlling and determining the quantities of the ingredients discharged. In operation, the entire measuring and dispensing mechanism shall produce the specified proportions of each ingredient.

501.9.2 Controls. All indicating devices that affect the accuracy of proportioning and mixing of concrete shall be in full view of and near enough to be read by the operator while concrete is being produced. The operator shall have convenient access to all controls.

501.9.3 Calibration. The proportioning devices shall be calibrated by the contractor in the presence of and subject to approval from the engineer. Calibration of the cement and aggregate proportioning devices shall be accomplished by weighing (determining the mass of) each component. Calibration of the admixture and water proportioning devices shall be accomplished by weight (mass) or volume. Tolerances in proportioning the individual components will be as follows:

Item	Tolerance
Cement, Weight (Mass) percent	0 to +4
Fine Aggregate, Weight (Mass) percent	± 2
Coarse Aggregate, Weight (Mass) percent	± 2
Admixtures, Weight (Mass) or Volume percent	± 3
Water, Weight (Mass) or Volume Percent	± 1

501.9.4 Verification of Yield. Verification of the proportioning devices may be required at any time by the engineer. Verification shall be accomplished as follows. With the cement meter set on zero and all other controls set for the designated mix, the activated mixer shall discharge mixed material into a 1/4 cubic yard (0.25 m³) container measuring 36 x 36 x 9 inches (1000 x 1000 x 250 mm). When the container is level-struck full, making provisions for settling the material into all corners, the cement meter shall show a discharge equal to the design proportion of cement for 1/4 cubic yard (0.25 m³). A tolerance of ± 1/8 inch (± 3 mm) from the top of the container will be permitted. If the correct yield is not obtained, the proportioning devices shall be adjusted to obtain the design mix or the proportioning devices shall be recalibrated as directed by the engineer.

501.9.5 Water Control. The rate of water supplied shall be measured by a calibrated flow meter coordinated with the cement and aggregate feeding mechanism and with the mixer. The rate shall be adjustable in order to control slump at the desired level.

501.9.6 Liquid Admixture. Liquid admixtures shall be dispensed through a controlled flow meter. A positive means to observe the continuous flow of material shall be provided. If an admixture requires diluting, the admixture shall be diluted and thoroughly mixed prior to introducing the admixture into the dispenser. When admixtures are diluted, the ratio of dilution and the mixing shall be approved by and performed in the presence of the engineer.

501.9.7 Concrete Mixer. The concrete mixer shall be approved by the engineer and shall be an auger-type continuous mixer used in conjunction with volumetric proportioning. The mixer shall produce concrete, uniform in color and appearance, with homogeneous distribution of the material throughout the mixture. Mixing time necessary to produce uniform concrete shall be established by the contractor and shall comply with other requirements of

these specifications. Only equipment found acceptable in every respect and capable of producing uniform results will be permitted.

501.9.7.1 Material Storage Capacity. The continuous mixer shall be capable of carrying sufficient unmixed dry bulk cement, fine aggregate, coarse aggregate, admixtures and water, in separate compartments to produce no less than 6 cubic yards (4.5 m³) of concrete at the job site. Each batching or mixing unit or both, shall carry in a prominent place a metal plate or plates on which are plainly marked the gross volume of the unit in terms of mixed concrete, discharge speed and the weight-calibrated constant of the machine in terms of a revolution counter or other output indicator.

501.9.7.2 Measurement of Cement. The continuous mixer shall be capable of positive measurement of cement being introduced into the mix. A recording meter visible to the operator and equipped with a ticket printout shall indicate the quantity.

501.9.7.3 Measurement of Water. The continuous mixer shall provide positive control of the flow of water and admixtures into the mixing chamber. Water flow shall be indicated by a flow meter and be readily adjustable to provide for minor variations in aggregate moisture. The mixer shall be capable of continuously circulating or mechanically agitating the admixtures.

501.9.7.4 Scalping Screen. The continuous mixer shall have a one-inch (25 mm) maximum size scalping screen over the fine aggregate bin to screen out mud balls, conglomerate lumps or any other contaminant material that could interrupt the flow of fine aggregate during proportioning.

501.9.7.5 Batching Operations. The continuous mixer shall be capable of being calibrated to automatically proportion and blend all components on a continuous or intermittent basis as required, and shall discharge mixed material through a conventional chute.

501.9.8 Handling Materials. Storage facilities for all material shall be designed to permit the engineer to make necessary inspections prior to the batching operations. The facilities shall also permit identification of approved material at all times, and shall be designed to avoid mixing with or contaminating by, unapproved material. Coarse and fine aggregate shall be furnished and handled so variations in the moisture content affecting the uniform consistency of the concrete will be avoided.

501.10 Air-Entrained Concrete .Air content for all classifications of concrete shall be determined in accordance with AASHTO T 152. Air-entrained concrete shall be used for the construction of the following items:

- (a) All retaining walls and bridge units, except culvert-type structures and seal courses.
- (b) Concrete median barriers.
- (c) All piles (not required for cast-in-place concrete piles).
- (d) Concrete pavements.
- (e) Approach slabs and paved approaches.
- (f) Concrete medians and median strips.
- (g) Sidewalks, curb ramps and steps.

(h) Curbs, gutters, curb and gutter and surface drain basins and drains.

(i) Concrete pedestals for signs, signals and lighting.

501.10.1 Other Concrete. All other concrete, except seal concrete, may be air-entrained but only in accordance with the requirements of these specifications.

501.10.2 Required Air Content. If air-entrained concrete is used, the designated quantity of air by volume shall be a minimum of 5.0 percent. For concrete pavement, the specified air content will apply to the measurements taken behind the paver or to measurements taken in front of the paver minus the established air loss through the paver.

501.10.3 Incorporation Procedures. Air-entraining admixtures shall be added to the concrete during the mixing process. The admixture shall be of such volume and strength that the admixture can be accurately measured and dispensed in accordance with the manufacturer's recommendations. The dispenser shall consistently deliver the required quantity of admixture within a tolerance of ± 3 percent.

501.10.4 Redosing. When the measured air content is below the minimum specified value, the contractor will be allowed to re-dose the concrete in the field one time. The contractor shall submit a Re-dosing Plan to the engineer for approval. The Re-dosing Plan shall address the following:

- (a) Field measurement of the air entrainment admixture
- (b) Brand of air entrainment admixture being used
- (c) Incorporation and mixing of the air entrainment admixture
- (d) The use of additional water

501.10.4.1 Allowed. The Re-dosing Plan shall be approved prior to use.

501.10.4.2 Other Requirements. All other requirements of this specification shall still apply.

501.10.4.3 Unacceptable Results. Concrete with a measured air content below 4.0 percent is unacceptable.

501.11 Concrete Admixtures for Retarding Set. If specified in the contract, an approved retarding admixture shall be provided and incorporated into the concrete. If not specified in the contract, the use of an approved retarding admixture will be permitted upon written notification from the contractor. Any retarding admixture shall be added in accordance with Sec 501.10.3 by means of a dispenser conforming to the requirements of that section. No direct payment will be made for furnishing the retarding admixture or for incorporating the admixture into the mixture.

501.12 Water-Reducing Admixtures. Type A water-reducing admixtures may be used in any concrete. When Type A water-reducing admixture is added to pavement concrete for paving purposes, a reduction of cement up to 25 lbs per cubic yard (15 kg/m³) will be permitted. The dosage rate of Type A water-reducing admixture shall be within the ranges recommended by the manufacturer and approved by the engineer. Any cementitious material substitution permitted by specification shall be based on the reduced cement content. Water-reducing admixtures shall be added in accordance with Sec 501.10.3 by means of a dispenser conforming to the requirements of that section. High range water-reducing admixtures may be used when specified or as approved by the engineer.

501.12.1 Modified B-2 Utilized. Modified B-2 concrete shall use a Type A or Type D water-reducer admixture.

501.12.2 Silica Fume and Metakaolin Utilized. Concrete utilizing silica fume or metakaolin shall use a water-reducer admixture that may be added by hand methods. The amount of water contained by the water-reducer admixture shall be included in the overall water content of the concrete.

501.12.3 Consistency Requirement. When a water-reducer admixture is used the maximum allowed slump may be increased to 6 inches for all concrete classes. The concrete shall be homogeneous with no aggregate segregation.

501.13 Accelerating Admixtures. The use of calcium chloride or other approved accelerating admixtures in concrete mixtures will not be permitted, except in concrete used for pavement repair in accordance with Sec 613.

501.14 Supplementary Cementitious Materials in Concrete .The contractor may use fly ash, GGBFS, silica fume or metakaolin in the production of concrete in accordance with these specifications. Ternary mixes will be allowed for all concrete classes. Ternary mixes are mixes that contain a combination of Portland cement and two supplementary cementitious materials. Supplementary cementitious materials may be used to replace a maximum of 40 percent of the Portland cement. The amount of each supplementary cementitious materials used in a ternary mix shall not exceed the limits specified herein.

501.14.1 Fly Ash. Approved Class C or Class F fly ash may be used to replace a maximum of 25 percent of the Portland cement on a pound for pound (kg for kg) basis in all concrete.

501.14.2 Ground Granulated Blast Furnace Slag. Approved GGBFS may be used to replace a maximum of 30 percent of the Portland cement on a pound for pound (kg for kg) basis in all concrete.

501.14.3 Silica Fume. Approved silica fume may be used to replace a percent of the Portland cement on a pound for pound (kg for kg) basis. The following limits shall apply when silica fume is used:

Silica Fume Replacement Limits, %		
Class of Concrete	Minimum	Maximum
MB-2	6	8
A-1, B, B-1, B-2, PCCP, Seal	----	8

501.14.3.1 Silica Fume Requirements. Silica fume shall be approved prior to use and be in accordance with ASTM C 1240, except as noted herein. If dry compacted form, the admixture shall be 100 percent silica fume with no admixtures. Silica fume slurries may contain other approved admixtures, such as water reducers or retarders, if the admixtures are included by the manufacturer of the silica fume admixture.

501.14.3.2 Manufacturer Certification. The contractor shall furnish to the engineer a manufacturer's certification along with the brand name, batch identification, quantity represented, percent solids and the type, name and quantity of any admixtures, that are provided in the silica fume admixture.

501.14.3.3 Silica Fume Test Results. The manufacturer's certification shall contain results of recent tests conducted on samples of the silica fume material taken during production or transfer and indicating conformance with Tables 1 and 3 of ASTM C 1240 and this

specification. The supplier shall further certify that the material being furnished is in accordance with this specification.

501.14.3.4 Silica Fume Approval. For approval prior to use, the supplier shall furnish the same information to: Construction and Materials, P.O. Box 270, Jefferson City, MO 65102, along with any requested samples for testing.

501.14.3.5 Silica Fume Slurry. Liquid silica fume admixture shall be protected from freezing at all times.

501.14.3.6 Admixture Compatibility. All admixtures used shall be compatible with the silica fume admixture and shall be recommended or approved in writing by the manufacturer of the silica fume admixture.

501.14.4 Metakaolin. Approved metakaolin may be used to replace a maximum of 15 percent of the Portland cement on a pound for pound basis in all concrete.

501.14.4.1 Metakaolin Requirement. Metakaolin shall be approved prior to use and be in accordance with AASHTO M321.

501.14.4.2 Manufacturer Certification. The contractor shall furnish to the engineer a manufacturer's certification along with the brand name, batch identification and quantity represented.

501.14.4.3 Metakaolin Test Results. The manufacturer's certification shall contain results of recent tests conducted on samples of the metakaolin taken during production or transfer and indicating conformance with AASHTO M321 and this specification. The supplier shall further certify that the material being furnished is in accordance with this specification.

501.14.4.4 Metakaolin Approval. For approval prior to use, the supplier shall furnish the same information to: Construction and Materials, P.O. Box 270, Jefferson City, MO 65102, along with any requested samples for testing.

501.14.5 Source Changes. Changes in class or source of fly ash, grade and source of GGBFS, brand and source of silica fume or brand and source of metakaolin used in concrete structures will be permitted only with written approval from the engineer. Only fly ash, GGBFS, silica fume or metakaolin resulting in concrete of the same color shall be used in any individual unit of the structure.

501.14.6 Mix Proportions. When fly ash, GGBFS, silica fume or metakaolin is used, an adjustment in design mix proportions will be required to correct the volume yield of mixture. Approval shall be obtained from the engineer prior to any change in mix design or proportions.

501.14.7 Mixing Water. Maximum mixing water shall be based on total cementitious material. The quantity of mixing water in the concrete shall be considered the net quantity after proper allowance has been made for absorption by the aggregate.

501.14.8 Measuring Fly Ash and Ground Granulated Blast Furnace Slag. Fly ash or GGBFS shall be measured in the same manner and with the same accuracy as cement. (The mass determination of) Fly ash or GGBFS may be weighed (determined) separately on the same scale as cement, provided the scale increments are such that the specified weighing (mass determination) accuracy can be maintained. If the (mass of) fly ash or GGBFS is weighed (determined) together with the cement, the (mass of) cement shall be weighed (determined) first and the accuracy shall apply to the combined weight (mass).

501.14.9 Measuring Silica Fume and Metakaolin. Silica fume or metakolin shall be measured by weight (mass) or volume within a tolerance of plus or minus 2 percent.

501.14.10 Silica Fume and Metakaolin Batching Sequence. Silica fume or metakaolin shall be added at the plant at the same point in the batch sequence as recommended by the manufacturer of the material . The silica fume or metakaolin may be added by hand methods.

501.14.11 Calculating Silica Fume Solids. For silica fume solutions, the quantity of liquid silica fume admixture needed to furnish the required silica fume solids shall be calculated based on the weight per gallon (mass per liter) and percent solids of the silica fume admixture being used.

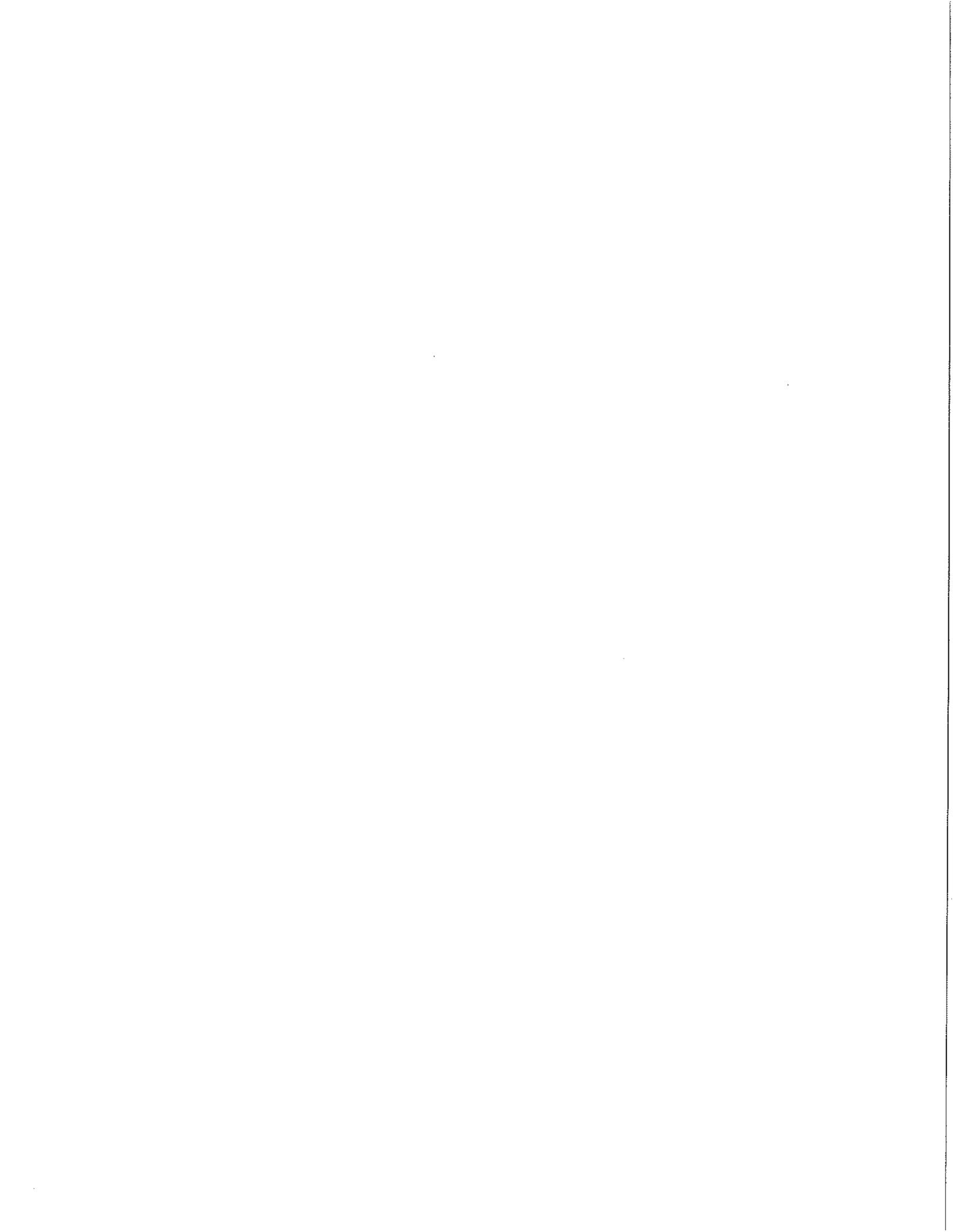
501.14.12 Measuring Cementitious Materials. Fly ash, GGBFS, silica fume or metakaolin will be considered as cement when measuring mixing time.

501.15 Commercial Mixture. If specified in the contract that an approved commercial mixture of concrete may be used, the contractor shall notify the engineer in writing, setting out for approval the source and proportions of the mixture proposed to be furnished. The statement shall include the following:

- (a) The types and sources of aggregate.
- (b) Type and source of cement and other cementitious material.
- (c) Scale weights (masses) of each aggregate proposed as pounds per cubic yard (kg/m^3) of concrete.
- (d) Quantity of water proposed, as pounds or gallons per cubic yard (kg or L per m^3) of concrete.
- (e) Quantity of cement proposed as pounds per cubic yard (m^3) of concrete. n.

501.15.1 Minimum Cement Content. The concrete shall contain no less than 517 pounds (305 kg) of cement per cubic yard (m^3). The use of fly ash, GGBFS, silica fume or metakaolin shall be in accordance with Sec 501.14. The plant shall comply with other requirements of these specifications or be as approved by the engineer. The concrete will be subject to acceptance or rejection by visual inspection at the job site.

501.15.2 Certification. The supplier shall furnish certification with the first truck load of each day's production of concrete that the material and mix proportions used are in accordance with the approved mixture. Upon completion of the work, plant certification shall be furnished by the supplier for the total quantity delivered.





SECTION 505

BRIDGE DECK CONCRETE WEARING SURFACE

SECTION 505.10 LOW SLUMP CONCRETE

505.10.1 Description. This work shall consist of constructing a wearing surface of low slump, dense concrete on a prepared surface in accordance with these specifications, as shown on the plans or as directed by the engineer.

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

Item	Section
Type I or II Cement	1019
Air-Entraining Admixture	1054
Water Reducing Admixture	1054
Burlap	1055
Polyethylene Sheeting	1058
Water	1070

505.10.2.1 Coarse aggregate shall be an approved crushed limestone, crushed quartzite, flint chat from the Joplin area or porphyry in accordance with Sec 1005.2, Gradation E, except that the sum of percentages of all deleterious substances shall not exceed one percent and the percentage of deleterious substances shall not exceed the following values:

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

505.10.2.1.1 Gradation D may be used when the plan thickness of the bridge deck overlay is 3 inches or greater.

505.10.2.2 Fine aggregate shall be in accordance with Sec 1005.3 and shall be Class A sand in accordance with Sec 501.

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

505.10.3 Concrete Mixture.

505.10.3.1 The contractor shall submit a mix design to Construction and Materials meeting the following properties:

Property	Requirement
Air Content, percent (minimum)	5.0
Slump, inches (mm)	1/2 ± 1/2 (13 ± 13)
Percent Fine Aggregate as Percent of Total Aggregate by Absolute Volume	50
Cement Content, lbs./cubic yard (kg/m ³)	818 to 827 (485 to 490)

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 (mass), 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 (150- by 300-mm) cylinders or from at least three 4- by 8- inch (100- by 200-mm) 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 (one per 85 m²) 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 The textured or scarified deck shall be sandblasted followed by an air blast. The sandblast 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 overlays against which new concrete is to be placed shall be sandblasted. Any loose or foreign material detected on the concrete surface prior to placement of the overlay shall be removed by sand or air blasting. 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 To assure that the thickness of the concrete overlay 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 (3 mm) less than the overlay 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 concrete that does not have sufficient clearance shall be removed.

505.10.7 Finishing Equipment.

505.10.7.1 The finishing machine shall be designed for striking off and finishing low slump concrete overlay. The machine shall be mechanically powered to operate forward and reverse in a smooth manner, under positive control of the operator. The basic machine shall be of a width to finish a basic 12-foot (3.6 m) width of overlay and shall be adjustable for wider placements. The finishing machine shall be designed to allow the screeds to be extended with bolted units to match the extension of the basic unit. The drive wheels shall be of the type that may be replaced with solid rubber wheels to permit travel upon previously completed lanes of overlay when striking off the abutting lanes.

505.10.7.2 The finishing machine shall be equipped with two oscillating transverse screeds. The screeds shall oscillate in a straight line. A swinging pendulum stroke shall not be used. The front screed shall vibrate uniformly for the full length of the screed. The vibrators shall be placed such that the screed vibrates efficiently and the frequency of the vibrators shall be controlled by the operator from the console to achieve the required density.

505.10.7.2.1 Screeds shall be held positive to the machine with rollers and, unless otherwise approved by the engineer, shall be equipped with screed guides such as to control the profile grade of the finished overlay. The screed stroke shall be synchronized to speeds not exceeding 50 strokes per minute, with infinite variable control from the console. The screeds shall be capable of vertical lift when the machine is reversed for travel, and controlled for downward direction to the finishing position to permit feathering of the screeds to any previously finished surface.

505.10.7.2.2 The bottom face of the screeds shall be at least 5 inches (125 mm) wide, with an effective pressure to produce no less than 75 psf (366 MPa). The bottom face of the screeds shall have a turned up leading edge to prevent tearing of the screeded surface and shall be adjustable for tilt and crown. The screed lengths shall be such to produce positive strike off and density of the concrete for at least 6 inches (150 mm) beyond the line where the saw cut for the longitudinal joint is to be made and to within one inch (25 mm) of the curb reinforcing steel or face of any curb barrier already in place.

505.10.7.3 The machine shall be equipped with a mechanically-powered adjustable auger positioned in front of the lead screed. The strike-off shall travel back and forth for the full width to be screeded and shall be properly designed to meter the concrete to the screeds.

505.10.7.4 Heavy duty support rails shall be used to support the finishing machine. Support rails shall be adjustable and the rail shall not deflect more than 1/32 inch (0.8 mm) between adjustable supports. Support rails shall be placed outside the area and parallel to axis of the area to be concreted. Support rails shall extend a sufficient distance beyond the end of the deck to allow the finishing machine to be completely removed from the deck surface such that hand finishing may proceed without interruption. The support rails shall be set to produce the final profile grade of the surface of the overlay. A hold-down device shot into the concrete will not be permitted unless the concrete is to be subsequently resurfaced. The proposed method of anchoring the support rails shall be submitted to the engineer for approval.

505.10.8 Placing and Finishing Concrete.

505.10.8.1 A lateral support for the concrete such as 2 x 4-inch (50 x 100 mm) lumber attached to the deck will be required at least 6 inches (150 mm) beyond the line where the saw cut for the longitudinal joint is to be made.

505.10.8.2 In order to avoid locating the longitudinal construction joints in a wheelpath, the joints shall be placed between the designated traffic lanes. The location of the longitudinal joints shall be subject to the approval from the engineer.

505.10.8.3 At transverse and longitudinal joints, the surface course previously placed shall be sawn to a straight vertical edge before the adjacent course is placed.

505.10.8.4 Transverse joints in the overlay will be permitted if approved by the engineer. These joints shall be located a minimum of 10 feet (3 m) from the centerline of bent.

505.10.8.5 The contractor shall take every reasonable precaution to secure a smooth riding bridge deck. Prior to placement operations, the contractor shall review with the engineer, equipment, procedures, personnel and previous results as well as inspection procedures to assure coordination. The contractor shall take every reasonable precaution to ensure that concrete can be produced and placed within the specified limits, continuously and with uniformity.

505.10.8.6 The areas of half-sole and full-depth repair shall have individual concrete placement up to bottom of the low slump concrete wearing surface.. These individual placements shall remain rough and shall be completed before the overlay course is started. Areas of half-sole, full-depth repair and all other patched areas shall be surface dried, sandblasted and cleaned prior to the placement of low slump concrete wearing surface.

505.10.8.7 Prior to placement of low slump concrete, the cleaned surface shall be thoroughly wetted for a minimum of three hours, then covered with polyethylene sheeting until the time of concrete placement. The surface shall be damp at the time the overlay 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.

505.10.8.8 The wheels of rubber wheeled vehicles or transport containers for the concrete shall not be permitted to contact any portion of the existing concrete surface prior to placement of the concrete. Protection shall be provided for the concrete surface by means of plywood, mats or other suitable material placed on the surface. Any loose or foreign material or rubber marks accidentally deposited on the surface shall be removed by the contractor prior to low slump concrete placement.

505.10.8.9 Placement of the concrete shall be a continuous operation throughout the pour. Only the minimum amount of concrete necessary for proper placement shall be placed in front of the screeds. If the concrete paver is stopped for any reason, all plastic concrete in front of the paver shall be covered with wet burlap. Concrete shall be poured and finished at a minimum of 2.5 cubic yards (2 m³) per hour for a 12-foot (3.6 m) wide pour, except when the contractor elects to pour a wider section, the rate of pour shall be increased proportionately.

When concrete is being mixed and placed at the specified minimum rate under normal operations, the finishing machine shall be designed such that the elapsed time between depositing the concrete on the deck and final screeding shall not exceed 10 minutes.

505.10.8.10 If concrete is added to the overlay behind the finishing machine, the area shall be mechanically consolidated again by the finishing machine.

505.10.8.11 After finishing, the contractor shall check the surface with a lightweight 10-foot (3 m) straightedge. Causes for irregularities exceeding 1/8 inch (3 mm) shall be eliminated and corrections shall be made.

505.10.8.12 The roadway surface finish shall be in accordance with Sec 703.3.5.5. The texture shall not extend into the areas within approximately 12 inches (300 mm) of curbs.

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 straightgedged by the engineer and all variations exceeding 1/8 inch (3 mm) in 10 feet (3 m) will be plainly marked. Areas more than 1/8 inch (3 mm) 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 Limitations of Operations.

505.10.9.1 Vehicle traffic shall not be permitted on the low slump concrete surface for 72 hours and until 3000 psi (21 MPa) compressive strength is attained.

505.10.9.2 No low slump concrete shall be placed at ambient temperatures below 45 F (7 C) or above 85 F (30 C). Concrete placement may begin when the air temperature and deck temperature is 45 F (7 C) and rising. Concrete shall not be exposed to freezing temperatures until a strength of 3000 psi (21 MPa) has been attained. Any concrete damaged by freezing shall be removed and replaced at the contractor's expense.

505.10.9.3 When the weather forecast predicts temperatures of 85 F (30 C) 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 (30 C). The mixed concrete when placed shall have a maximum temperature of 90 F (32 C).

505.10.9.4 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.

505.10.9.5 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 (7 kg) 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.

505.10.10 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.

505.10.11 Repair.

505.10.11.1 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 sandblasting and then air blasting. The surface shall be comparable to the original concrete surface prior to the original overlay being placed.

505.10.11.2 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.

505.10.12 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. The area of concrete wearing surface will be measured and computed to the nearest square yard (m^2). This area will be measured longitudinally from end to end of bridge deck and transversely between roadway face of curbs, excluding from measurement the area of drains and expansion devices. The revision or correction will be computed and added to or deducted from the contract quantity.

505.10.13 Basis of Payment. Payment for the above described work shall be considered completely covered by the contract unit price per square yard (m^2) of concrete wearing surface.

SECTION 505.20 LATEX MODIFIED CONCRETE

505.20.1 Description. This work shall consist of constructing a wearing surface of latex modified concrete on a prepared surface in accordance with these specifications 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 (30 C). Drums of latex admixture to be stored at the work site in direct sunlight shall be completely covered with a suitable insulating blanket material to maintain an enclosed temperature below 85 F (30 C).

505.20.3 Concrete Mixture.

505.20.3.1 The contractor shall submit a mix design to Construction and Materials meeting the following requirements:

Property	Requirement
Air Content, percent	0 to 6.5
Slump, inches (mm)	4 to 6 (100 to 150)
Percent Fine Aggregate as percent of Total Aggregate by Absolute Volume	50 to 55
Cement Content, lbs./cubic yard (kg/m^3) min.	658 (390)
Latex Emulsion Admixture, gallons/cubic yard. (L/kg) min.	24.5(121.29)
Net Water/Cement Ratio, max., lbs. ^a (kg) water/lbs. (kg) cement	0.40

^a Net water shall be considered the quantity of mixing water added, plus the non-solid portion of the latex emulsion.

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

505.20.3.3 Anti-foam additives, as recommended by the latex emulsion manufacturer, may be required if the concrete mixture entrains air above the specified amount.

505.20.3.4 Air-entraining admixtures shall not be added.

505.20.4 Testing. Testing will be done in accordance with Sec 505.10.4, except the slump test will be conducted 4 to 5 minutes after discharge from the mixer. During the waiting period, concrete shall be deposited on the deck and shall not be disturbed.

505.20.5 Mixing.

505.20.5.1 The concrete shall be volumetrically mixed at the bridge site by a continuous mixer in accordance with Sec 501. In addition to other requirements, the mixer shall provide positive control of the latex emulsion into the mixing chamber and the latex emulsion shall calibrate to within ± 2 percent of that required. The mixer shall be capable of continuously circulating the latex emulsion and shall have a flow-through screen between the storage tank and the discharge.

505.20.5.2 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. Final finishing shall be completed before the formation of a plastic surface film.

505.20.5.3 The moisture content of aggregate 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 the uniform consistency of the concrete.

505.20.5.4 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.

505.20.6 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 and new decks, within 24 hours prior to placing latex modified concrete, the entire surface shall be thoroughly cleaned by sandblasting followed by an air blast.

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 1500 to 2500 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 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 Expansion joints and dams shall be formed in the concrete overlay. Formation of the joint by sawing through the overlay will not be permitted.

505.20.8.3 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.

505.20.8.4 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. 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.

505.20.8.5 During placement of the overlay, 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.

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

505.20.8.7 The surface shall receive a wet cure for at least 48 hours.

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

505.20.8.9 No surface sealing shall be applied to the latex modified concrete wearing surface.

505.20.9 Limitations of Operations.

505.20.9.1 No latex modified concrete shall be placed when the ambient or deck surface temperature is above 85 F (30 C). Deck temperature shall be determined in accordance with MoDOT Test Method TM 20.

505.20.9.2 No latex modified concrete shall be placed at ambient or deck surface temperatures below 45 F (7 C). Latex modified concrete shall be protected to maintain a minimum specified curing temperature of 45 F (7 C). Any concrete damaged by freezing or that is exposed to a temperature of less than 45 (7 C) during the first 8 hours after placement shall be removed and replaced at the contractor's expense.

505.20.9.3 The temperature of the latex modified concrete at time of placement shall be between 45 F (7 C) and 90 F (32 C). If either the aggregate or water is heated, the maximum temperature for each shall be 100 F (38 C) 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.

505.20.9.4 No vehicular traffic shall be permitted on the latex modified concrete surface until the concrete is at least 96 hours old and has attained a minimum compressive strength of 3000 psi (21 MPa).

505.20.9.5 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.

505.20.9.6 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.

505.20.9.7 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.

505.20.9.8 Transverse joints in the overlay may be permitted if approved by the engineer. These joints shall be located a minimum of 10 feet (3 m) from the centerline of bent.

505.20.9.9 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.

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

505.20.10 Removal. Material removal and disposal shall be in accordance with Sec 505.10.10.

505.20.11 Repair. Repair shall be in accordance with Sec 505.10.11.

505.20.12 Method of Measurement. Measurement of latex modified concrete will be in accordance with Sec 505.10.12.

505.20.13 Basis of Payment. Payment for latex modified concrete will be made in accordance with Sec 505.10.13.

SECTION 505.30 SILICA FUME CONCRETE

505.30.1 Description. This work shall consist of constructing a wearing surface of silica fume concrete on a prepared surface in accordance with these specifications as shown on the plans or as directed by the engineer.

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

Item	Section
Type I Cement	1019
Air Entraining Admixture	1054
Retarding Admixture	1054
Water-Reducing Admixture	1054
Burlap	1055
Polyethylene Sheeting	1058

505.30.2.1 Silica fume shall be in accordance with Sec 501

505.30.2.2 Aggregate shall be in accordance with Sec 505.10.2.

505.30.2.3 Pozzolanic material, other than silica fume or Portland pozzolan cements shall not be used.

505.30.2.4 A retarding admixture may be permitted, if recommended by the manufacturer of the silica fume admixture.

505.30.2.5 Approved Type F or G high range water-reducing admixtures will be permitted if specified or recommended by the supplier of the silica fume admixture.

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, minimum	5.0
Slump, inches (mm),	3 - 7 1/2 (75-190)
Cement Content, pounds/cubic yard (kg/m ³), min	640 (380)
Water/Cement Ratio lbs. (kg) water/lbs. (kg) cementitious materials, max.	0.37
Silica Fume, % replacement of cement	6-8
Percent Fine Aggregate (as percent of total fine and coarse aggregate by absolute volume)	50 - 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. 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 shall be thoroughly and continuously wetted with water at least three hours before placement of the overlay 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.

505.30.8.2 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.

505.30.8.2.1 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.

505.30.8.2.2 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 (4 L) per minute per nozzle.

505.30.8.3 The surface shall receive a wet cure for at least 7 days. Time when the ambient temperature is below 45 F (7 C) will not be counted as cure time. Cure shall be continued until 3000 psi (21 MPa) compressive strength has been attained.

505.30.8.4 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 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.

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

505.30.8.6 No surface sealing shall be applied to the silica fume concrete wearing surface.

505.30.9 Limitations of Operations. Operations shall be limited in accordance with Sec 505.10.9, except as noted herein.

505.30.9.1 Vehicular traffic shall not be permitted on the silica fume concrete surface for seven days, and in no case until 3000 psi (21 MPa) compressive strength is attained.

505.30.9.2 Silica fume concrete shall not be placed when the air temperature or deck temperature is below 45 F (7 C) or above 85 F (30 C). Concrete placement may begin when the air temperature and deck temperature are 45 F (7 C) and rising. Concrete shall not be exposed to freezing temperatures until a strength of 3000 psi (21 MPa) has been attained. Any concrete damaged by freezing shall be removed and replaced at the contractor's expense.

505.30.9.3 When the weather forecast predicts temperatures of 85 F (30 C) or higher, the contractor shall schedule placing and finishing silica fume concrete during hours in which the ambient temperature will be lower than 85 F (30 C). The mixed concrete shall not have a temperature higher than 85 F (30 C) when placed.

505.30.9.4 Since silica fume concrete may not exhibit bleed water, the probability of plastic shrinkage cracking is increased. At surface evaporation rates above 0.1 pound per square foot per hour (0.05 kg/m²/hr), plastic shrinkage cracking is probable and the contractor shall 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 permitted as provided for in this specification. Surface evaporation rates may be predicted from mix temperature, air temperature, relative humidity and wind velocity, using Figure 1 of the 1986 revised edition of ACI 308-81, *Standard Practice for Curing Concrete*.

505.30.10 Removal. Material removal and disposal shall be in accordance with Sec 505.10.10.

505.30.11 Repair. Repairs shall be in accordance with Sec 505.10.11.

505.30.12 Method of Measurement. Measurement of silica fume concrete will be in accordance with Sec 505.10.12.

505.30.13 Basis of Payment. Payment for silica fume concrete will be made in accordance with Sec 505.10.13.

SECTION 505.40 LATEX MODIFIED HIGH EARLY STRENGTH CONCRETE

505.40.1 Description. This work shall consist of a wearing surface of latex modified high early strength concrete constructed on a prepared surface in accordance with this specification and in accordance with lines, grades, thickness and typical cross sections shown on the plans or as directed by the engineer.

505.40.2 Material. All material shall be in accordance with Sec 505.10, Division 1000, Materials Details and specifically as follows:

Item	Section
Latex Emulsion Admixture	1054
Polyethylene Sheeting	1058
Water	1070

505.40.2.1 With approval of the engineer, a Type HE high-early-strength cement, in accordance with ASTM C 1157, may be used. Type III cement will not be permitted.

505.40.2.2 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 or Gradation F, except the percentage of deleterious substances shall not exceed the following values, and the sum of percentages of all deleterious substances shall not exceed one percent.

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

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

505.40.2.4 With approval of the engineer, other gradations of coarse or fine aggregate may be used, however all quality requirements, including a maximum of 2.0 percent passing the No. 200 (75 μ m) for fine and coarse aggregate, shall apply and the maximum aggregate size shall not exceed that of Sec 1005, Grade E aggregate.

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

505.40.2.6 Latex admixture shall be kept in suitable enclosures which will protect it from freezing and from exposure to temperatures in excess of 85°F (30°C).

505.40.3 Concrete Mixture.

505.40.3.1 The concrete mixture shall meet the following requirements:

Property	Specific Value
Air Content percent	0 to 6.5
Slump, inches (mm)	3 to 6 (75 to 150)
Percent Fine Aggregate as percent of total aggregate by weight	50 to 55
Cement Content, lb/cu yd (kg/m ³) min.	658 (390)
Latex Emulsion Admixture, gal/cu yd (L/m ³)	24.5 (121.3)
Net Water-Cement Ratio, max.	0.40
Lbs. ^a (kg) of water/lbs. (kg) of cement	

^aNet water shall be considered the quantity of mixing water added plus the non-solid portion of the latex emulsion.

505.40.3.2 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. The tests are to be performed by a qualified commercial laboratory.

505.40.3.3 The mixture shall be designed to develop a minimum 28-day compressive strength of 4500 psi (31 MPa).

505.40.3.4 Anti-foam additives as recommended by the latex emulsion manufacturer may be required if the concrete mixture entrained air is above the specified amount.

505.40.3.5 Air-entraining admixtures shall not be added.

505.40.3.6 A set control in accordance with the cement manufacturer's recommendation may be considered.

505.40.3.7 Admixtures containing calcium chloride shall not be used.

505.40.4 **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 provision. The mix design shall also include actual test results for the following information:

- (a) Air.
- (b) Slump.
- (c) Compressive strengths at 4-hours, 8-hours, 12-hours, 24-hours, 7-days and 28-days. Compressive strengths determined using 6 x 12 inch (150 x 300 mm) cylinders.
- (d) Results of chloride permeability testing.

505.40.4.1 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.

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

505.40.5 **Testing.** Testing will be done in accordance with Sec 505.10, except that the slump test will be conducted 4 to 5 minutes after discharge from the mixer. During the waiting period, concrete shall be deposited on the deck and shall not be disturbed.

505.40.6 **Mixing.**

505.40.6.1 The concrete shall be volumetrically mixed at the bridge site by a continuous mixer in accordance with Sec 501. In addition to other requirements, the mixer shall provide positive control of the latex emulsion into the mixing chamber, and the latex emulsion shall calibrate to within ± 2 percent of that required. The mixer shall be capable of continuously circulating the latex emulsion and have a flow-through screen between the storage tank and the discharge.

505.40.6.2 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. Final finishing shall be completed before the formation of a plastic surface film on the surface.

505.40.6.3 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 the uniform consistency of the concrete.

505.40.6.4 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.

505.40.6.5 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.

505.40.6.6 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.

505.40.7 Surface Preparation. Surface preparation shall be in accordance with Sec 505.10 except as specified herein.

505.40.7.1 Prior to scarifying or chipping on concrete adjacent to latex modified high 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 high 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.

505.40.7.2 On both old and new decks within 24 hours before latex modified high early strength concrete placement begins, the entire surface shall be thoroughly cleaned by hydro blasting followed by an air blast in accordance with Sec 505.10.

505.40.8.0 Finishing Equipment.

505.40.8.1 The finishing machine shall be self-propelled with one or more rollers, augers and vibratory pans capable of 1500 to 2500 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.

505.40.8.2 Support rails shall be in accordance with Sec 505.10.

505.40.9 Placing and Finishing Concrete. Placing and finishing shall be in accordance with Sec 505.10 except as specified herein.

505.40.9.1 Prior to placement of latex modified high 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 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.

505.40.9.2 Expansion joints and dams shall be formed in the concrete overlay. Formation of the joint by sawing through the overlay will not be allowed.

505.40.9.3 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.

505.40.9.4 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 face. Care shall be taken not to texture too deep and not to tear the surface.

505.40.9.5 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. 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.

505.40.9.6 During placement of the overlay, 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.

505.40.9.7 The overlay concrete shall be moist cured from the time placed until opened to traffic.

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

505.40.9.9 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 high early strength concrete has attained a compressive strength of at least 3200 psi (22 MPa).

505.40.9.10 The thickness of the overlay shall not exceed 3 inches (75 mm), unless otherwise approved by the engineer.

505.40.9.11 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 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.

505.40.9.12 After placement and curing of the latex modified high early strength concrete, the finished deck will be tested to detect unbonded areas.

505.40.9.13 No surface sealing shall be applied to the latex modified high early strength concrete wearing surface.

505.40.10 Limitations of Operations.

505.40.10.1 No latex modified high early strength concrete shall be placed when the ambient or deck surface temperature is above 85°F (30°C). Deck temperature shall be determined in accordance with MoDOT Test Method T20.

505.40.10.2 Since latex modified high 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 (0.05 kg/m²/hr) 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 (40.7 L/hr/m²). 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 inches (80 μm) 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.

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 high early strength concrete shall be placed at ambient or deck surface temperatures below 45°F (7°C). Latex modified high early strength concrete shall be protected to maintain a minimum specified curing temperature of 45°F (7°C). 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 (7°C) 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 high early strength concrete at time of placement shall be between 45°F (7°C) and 90°F (32°C). If either the aggregate or water is heated, the maximum temperature for each shall be 100°F (38°C) 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 high early strength concrete surface until the latex modified high early strength concrete has attained a minimum compressive strength of 3200 psi (22 MPa). 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 may be permitted if approval by the engineer. Transverse joints shall be located a minimum of 10 feet (3 m) 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.

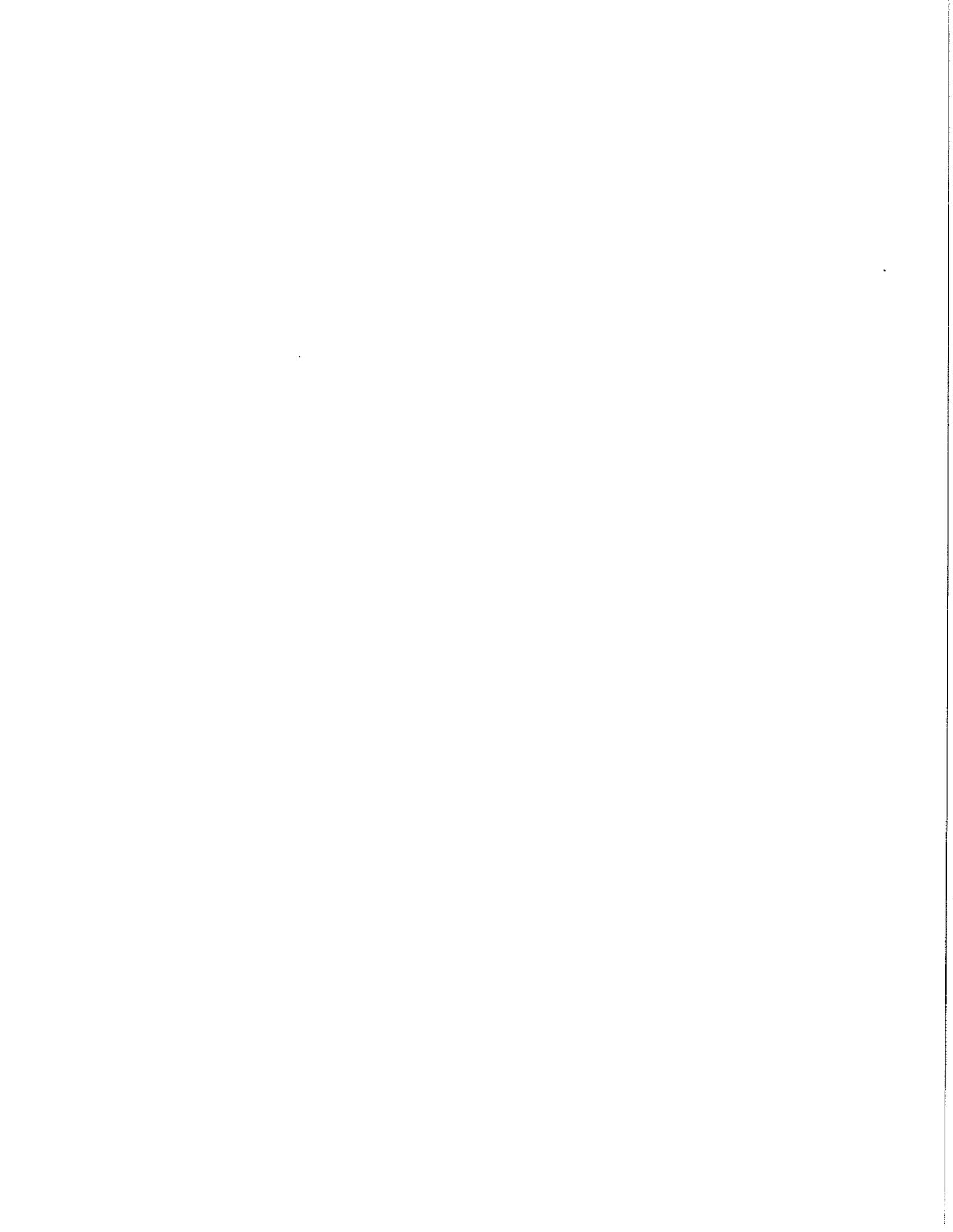
505.40.10.13 Adequate precautions shall be taken to protect freshly placed concrete from rain. All placing operations shall stop when rain begins. The engineer may order removal of any material damaged by rainfall and such material shall be replaced in accordance with this specification at the contractor's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

505.40.11 **Removal.** Material removal and disposal shall be in accordance with Sec 505.10.

505.40.12 **Repair.** Repair shall be in accordance with Sec 505.10.

505.40.13 **Method of Measurement.** Measurement will be in accordance with Sec 505.10.

505.40.14 **Basis of Payment.** The basis for payment will be in accordance with Sec 505.10.





SECTION 622

PAVEMENT AND BRIDGE SURFACE REMOVAL AND TEXTURING

622.1 Description. This work shall consist of removing or texturing the surface of existing pavement and bridge decks as shown on the plans. The term "pavement" as used in Sec 622 will be considered reference to the paved portion of the highway within the limits of construction, including bridge decks.

622.2 Construction Requirements.

622.2.1 The pavement surface shall be removed or textured to the depth, width, grade and cross slope shown on the plans or as directed by the engineer.

622.2.2 Unless specified otherwise in the contract, the contractor shall accept full ownership of all material generated by removal or texturing operations and shall indemnify the Commission of responsibility for and pay all costs relating to generation, handling, storage, treatment, transportation, disposal, or any future use of the material.

622.2.3 Depth transitions at the beginning and end of a project, side roads, bridge ends or other locations shown on the plans shall be milled by using equipment and a process approved by the engineer. The equipment will not be required to have an automatic grade leveling and slope control device or a means of removing and discharging millings from the pavement, unless specified otherwise. Any necessary pavement marking in the transition areas shall be as directed by the engineer and at the contractor's expense.

622.2.4 The contractor shall provide signing informing motorists of coldmilled areas open to traffic, at the contractors expense. The contractor may use static signs, changeable message signs, or a combination thereof to provide this warning. Signing shall be deployed in advance of an exit from the mainline prior to the milled area to allow motorists an opportunity to take an alternate route. Signing shall also be placed on any ramps leading into the milled area. If an alternate route cannot be provided, deployment of the signs shall be located in advance of the milled area to allow motorists to safely negotiate the section of milled pavement. Sign locations shall be approved by the engineer prior to installation. Signing shall be in accordance with Sec 616. Sign layout for static signs shall be as shown in the standard plans. Changeable message signs shall be programmed as directed by the engineer.

SECTION 622.10 COLD MILLING EXISTING PAVEMENT FOR REMOVAL OF SURFACE

622.10.1 Description. This work shall consist of coldmilling the existing pavement surface to the depth, profile and cross slope shown on the plans and removing and disposing of the milled material.

622.10.2 Equipment.

622.10.2.1 The equipment for milling and removing the pavement surface shall be capable of removing a thickness of bituminous or concrete material to the specified depth and providing a uniform profile and cross slope.

622.10.2.2 The equipment shall be capable of accurately and automatically establishing profile grades within 1/8 inch (3 mm) of each edge of the machine. The milling equipment shall be regulated by an automatically controlled grade leveling and slope control device. The device shall provide control for producing a uniform surface to the established grade and a cross slope in accordance with the typical section. The device shall also be equipped with the necessary controls to permit the operator to adjust or vary the slope as directed by the engineer.

622.10.2.3 The equipment shall have provisions for controlling dust and other particulate matter created by the cutting action. The equipment shall also have an effective means of removing cuttings from the pavement and discharging them into a hauling unit, all in one operation, as the pavement is milled.

622.10.3 Construction Requirements.

622.10.3.1 In the event the milled surface begins to ravel under traffic or other problems resulting from the milling occur, restrictions on the amount of time that a milled area may be left open will be determined by the engineer.

622.10.3.2 The milling operations, except in depth transition areas, shall be regulated by an automatically controlled grade leveling and slope control device.

622.10.3.3 The roadway pavement surface shall be removed and planed around and over manholes, utility valves and drainage appurtenances within the limits of the work as directed by the engineer. Any damage to manholes, utility valves or drainage appurtenances by the removal and planing operation shall be repaired by the contractor at the contractor's expense. After removal of existing material around manholes, utility valves and other appurtenances, the contractor shall place a temporary wedge around the appurtenance. The temporary wedge shall consist of bituminous or another approved material at a slope that will allow safe transition over the appurtenance by through traffic and of a thickness and design that the material remains intact while under traffic. Bituminous wedges shall be removed prior to resurfacing.

622.10.3.4 The milled surface of each layer shall be substantially free from waves or irregularities. The final milled surface shall not vary from a 10-foot (3 m) straightedge, applied parallel to the centerline, by more than 1/4 inch (6 mm). Spalled areas presenting a hazard shall be repaired using an approved bituminous pavement. The texture of the final milled surface shall be a grid surface with discontinuous longitudinal striations.

622.10.3.5 Existing shoulder material shall be removed as necessary to ensure no ponding of water on the driving surface occurs after the milling operation.

622.10.3.6 Care shall be exercised not to damage existing concrete pavement. The concrete pavement surface may be scarified as shown on the plans or approved by the engineer.

622.10.3.7 Loose material not picked up by the milling machine shall be removed from the roadway or bridge deck surface immediately behind the milling operation, except in areas with earth or stabilized aggregate shoulders. Loose material may be swept to the shoulders as approved by the engineer.

622.10.3.8 The contractor shall provide pavement marking as shown on the plans through the limits of the milled surfaces in accordance with Sec 620.

622.10.4 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, measurement for removal of the existing pavement surface will be computed to the nearest square yard (m^2). The correction will be added to or deducted from the contract quantity.

622.10.5 Basis of Payment. The accepted quantity of removal of existing surface will be paid for at the contract unit price for each of the pay items included in the contract. No direct payment will be made for removal of shoulder material by milling or other methods as required to provide drainage in accordance with Sec 622.10.3.5, unless shoulders are to be removed as part of the contract. No direct payment will be made for loading, hauling, stockpiling or disposing of milled material, repairing spalled areas, placing and removing temporary wedges, providing temporary pavement marking or performing other items incidental to completion of this work.

SECTION 622.20 COLD MILLING PAVEMENT FOR A DRIVING SURFACE

622.20.1 Description. This work shall consist of fine-tooth coldmilling to improve the profile, cross slope or texture of an existing pavement surface as shown on the plans or as directed by the engineer. The finished profile shall provide a smooth riding surface, free from gouges, and shall have a uniform textured appearance.

622.20.1.1 Locations may be field adjusted in length by the engineer, not to exceed 1/4 mile (0.5 km) for any one location and provided the total area for all locations is not changed, without change in payment. All specified locations shall be milled.

622.20.1.2 Contractors shall make their own conclusions concerning the quantity of material to be removed. The actual depths of milling will vary due to rut depths, drainage and profile requirements.

622.20.2 Equipment. Equipment for profiling, texturing and removing the pavement surface shall be in accordance with Sec 622.10, except as modified herein.

622.20.2.1 The minimum drum cutting width shall be 12 feet (3.6 m), unless specified otherwise in the contract.

622.20.2.2 The carbide cutting teeth shall be uniform in diameter, with a uniform length of ± 0.02 inch (± 0.5 mm). In addition, the tooth holder blocks shall be uniform and shall not vary the cutting radius of the mandrel by more than ± 0.02 inch (± 0.5 mm).

622.20.2.3 Removing millings from the pavement and discharging the millings into a hauling unit may be individual operations.

622.20.3 Construction Requirements.

622.20.3.1 Removal of material for rut removal shall be to the approximate depth of the bottom of the wheel rut in the lane being milled. The bottom of the rut shall be textured, but only minimal material removed. Milling shall be done in an approximate lane width, but may start to the right of the centerline in the approximate left wheelpath, extending into the shoulder to allow drainage, leaving the existing centerline marking in place.

622.20.3.2 Removal of material for surface texturing shall be done for the full lane width, to the depth needed in order to texture all of the described areas.

622.20.3.3 After the proper combination of mandrel speed and forward speed have been established to produce the required texture, the daily operation shall be uniform and

continuous for other than repair or emergency operations. The milling machine shall not be halted to load or unload trucks, or to take on water.

622.20.3.4 The entire surface shall be textured, substantially free from waves or irregularities, and shall not vary from a 10-foot (3 m) straightedge, applied parallel to the centerline, by more than 1/8 inch (3 mm). There may be occasional exceptions where the bottom of a wheelpath may not be textured in order to maintain an acceptable profile. Spalled areas shall be repaired using an approved bituminous patching material.

622.20.3.5 The texture produced for the finished pavement shall be a uniform surface with longitudinal striations. There shall be a maximum lateral distance of 0.2 inch (5 mm) between adjacent longitudinal striation mark lines. The longitudinal distance from the center of a strike mark to the center of the next successive strike mark in line shall not exceed 5 inches (125 mm). The longitudinal successive strike marks shall approximate a continuous grooved line. The difference between the high and low of the surface texture shall be approximately 1/16 inch (2 mm).

622.20.3.6 The pavement surface shall be removed and milled around and over appurtenances, such as manholes, utility valves and drainage features, within the limits of the work as directed by the engineer. Any damage to appurtenances by the milling and removal operation shall be repaired by the contractor at the contractor's expense. The final milled pavement surface shall be smoothly transitioned at all appurtenances located in the pavement to maintain an acceptable profile.

622.20.3.7 Material adjacent to the lane being milled shall be removed as necessary to provide a smooth transition and to ensure no ponding of water on the driving surface after the milling operation. There will be no pay for additional milling width beyond lane width as required for drainage. Removal in the traffic lanes shall be with the same equipment, providing the same texture. Removal of shoulder material may be with other milling equipment meeting the engineer's approval.

622.20.3.8 Loose material not picked up by the milling machine shall be removed from the roadway immediately behind the milling operation. In areas with earth or aggregate shoulders, the loose material may be swept to the shoulders when approved by the engineer. If required by the engineer, the finished surface shall be wetted just prior to returning to traffic to reduce traffic visibility problems due to dust.

622.20.3.9 Obliterated edgelines next to a shoulder will not be required to be replaced by the contractor, unless specified in the contract. Any other pavement marking removed by the contractor's operations shall be replaced with temporary pavement marking in accordance with Sec 620, except when permanent pavement marking is specified in the contract. Prior to installation of permanent pavement marking, all joints and cracks shall be cleaned and sealed with hot-poured, elastic type concrete joint sealer in accordance with Sec 1057.

622.20.4 Method of Measurement. The roadway lane width will be assumed for computing milling quantities. Final measurement will not be made except for authorized changes during construction or where appreciable errors are found in contract quantity. Where required, measurement for coldmilling of the existing pavement surface will be computed to the nearest square yard (m²). The corrections will be added to or deducted from the contract quantity.

622.20.5 Basis of Payment. The accepted quantity of coldmilling of existing pavement surface will be paid for at the contract unit price for each of the pay items included in the contract. No direct payment will be made for loading, hauling, stockpiling or disposing of milled material, repairing spalled areas, temporary pavement marking or other items incidental to completion of the work.

SECTION 622.30 DIAMOND GRINDING OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT

622.30.1 Description. This work shall consist of grinding concrete pavement to provide good riding characteristics, a surface texture and proper drainage. The finished surface shall be as shown on the plans or as directed by the engineer.

622.30.2 Equipment. The equipment shall be of a size that will grind a strip at least 3 feet (1 m) wide using diamond blades, and shall not cause spalls at cracks, joints or other locations.

622.30.3 Construction Requirements.

622.30.3.1 The construction operation shall be scheduled and proceed in a manner that produces a uniform finished surface. Auxiliary or ramp lane grinding shall transition from the edge of the mainline as required to provide drainage and an acceptable riding surface. Grinding of bridge decks will not be permitted unless specified in the contract.

622.30.3.2 Pavement undersealing or pavement repair, if required, shall be completed prior to any grinding.

622.30.3.3 Grinding shall be accomplished in a manner that eliminates joint or crack faults and provides lateral drainage by maintaining a constant cross slope between grinding extremities in each lane. A maximum tolerance of 1/16 inch (2 mm) will be allowed for adjacent sides of joints and cracks, except that under no circumstances shall the grinding depth exceed 3/4 inch (20 mm) from the top of the original surface. When grinding across faulted joints, a minimum of a 20-foot (6 m) transition onto the approach side slab shall be used.

622.30.3.4 The cross slope of the pavement shall be as shown on the plans and shall have no depressions or misalignment of slope greater than 1/4 inch in 12 feet (2 mm/m) when measured with a 12-foot (3.6 m) straightedge placed perpendicular to the centerline. Areas of deviation shall be reground. Straightedge requirements will not apply across longitudinal joints or outside the ground area.

622.30.3.5 As soon as practical after grinding, the surface will be straightedged longitudinally and all variations exceeding 1/8 inch in 10 feet (1 mm/m) will be plainly marked. Areas of deviation shall be reground.

622.30.3.6 Substantially all of the pavement surface shall be textured. Extra depth grinding to eliminate minor depressions in order to provide texturing on 100 percent of the pavement surface will not be required. No unground surface area between passes will be permitted.

622.30.3.7 The grinding process shall produce a final pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture. The line-type texture shall contain parallel longitudinal corrugations that present a narrow ridge corduroy-type appearance. The peaks of the ridges shall be approximately 1/32 inch (0.8 mm) higher than the bottoms of the grooves. The grooves shall be evenly spaced. There shall be approximately 50-55 grooves per foot (164-180 grooves/m), measured perpendicular to the centerline.

622.30.3.8 The contractor shall remove and dispose of all residue from the grinding in a manner and at a location to satisfy environmental regulations. The contractor shall have the engineer's approval for the method of spreading and disposal of the residue prior to beginning any grinding operations.

622.30.3.8.1 Solid residue shall be removed from the pavement surface before any residue is blown by traffic action or wind.

622.30.3.8.2 Residue shall not be permitted to encroach on open lanes.

622.30.3.8.3 The residue shall not enter into gutters or closed drainage systems. Suitable means to restrict the infiltration of the residue into a closed drainage system shall be provided.

622.30.3.8.4 The contractor may disperse residue onto unpaved shoulders, adjacent roadside embankments, or median ditch areas of divided highways where the residue runoff can percolate into the soil, unless specified otherwise in the contract. The spread rate shall not generate surface runoff. If surface runoff occurs at a grinding location, the contractor shall haul the residue to an approved location at the contractor's expense.

622.30.3.8.5 Discharge of any residue runoff shall not flow into adjacent rivers, streams, lakes, ponds or other open bodies of water.

622.30.3.8.6 Residue shall not be spread within 100 feet (30 m) of any streams, lakes or other open bodies of water, or within 15 feet (5 m) of a water filled ditch.

622.30.3.8.7 The contractor shall use appropriate equipment and methods so the discharging of the residue does not cause erosion of soil or damage to established vegetation along the roadway. The contractor shall repair and reseed any areas where the discharge of grinding residue causes damage to roadway slopes or vegetated areas at the contractor's expense.

622.30.3.8.8 If the solids concentration of discharged residue at any particular area is determined to be excessive by the engineer, the contractor shall provide equipment and material to flush the areas with water as directed by the engineer, at the contractor's expense.

622.30.3.8.9 Obliterated edgelines next to a shoulder will not be required to be replaced by the contractor unless specified in the contract. Any centerline or lane line markings removed by the contractor's operations shall be replaced with temporary pavement marking material in accordance with Sec 620, unless permanent pavement marking material is specified in the contract. Prior to installation of permanent pavement marking material, all joints and cracks shall be cleaned and sealed if specified in the contract.

622.30.4 Smoothness Requirements.

622.30.4.1 An initial profile index of representative portions of the pavement will be available through the project contact person upon written request. After the contract is awarded, the initial profile index will be available from the engineer. This information represents a summary of conditions found to exist at the time the survey was made. The availability of this information will not constitute a guarantee that a profile other than that indicated will not be encountered at the time of grinding. This information is provided only to give the contractor an idea of the condition of the pavement in regard to smoothness when bidding on this work. The contractor assumes the risk of error if the information is used for any purpose other than the intended purpose. The Commission makes no representation as to the accuracy of the initial profile index, since the accuracy of the profile index is limited by the number of profiles taken. Any assumption the contractor makes from this data will be at the contractor's risk, none are intended by the Commission.

622.30.4.2 Prior to performing any grinding work, the contractor shall provide a control profilograph trace in accordance with Sec 502. This control trace will be used to identify the required smoothness for the project. Each segment of the finished ground surface shall have a final profile index of 35 percent of the control profilograph trace or 30 inches per mile

(45 mm/km), whichever is greater, and shall not include any bumps exceeding 0.5 inch in 25 feet (13 mm in 8 m). Depressed pavement areas due to subsidence or other localized causes and areas where the maximum cut at mid panel or a fault restricts further grinding, will be excluded from testing with the profilograph when approved by the engineer.

622.30.4.3 Profilograph testing shall end 15 feet (5 m) prior to excluded areas and shall resume 15 feet (5 m) following excluded areas.

622.30.4.4 The ground surface shall be tested and evaluated in accordance with Sec 502, with the following modifications:

(a) The test shall be run and the profilogram shall be evaluated using the same procedure as for the control trace.

(b) Each segment for which continuous grinding is designated will be evaluated individually, and shall meet the smoothness and bump requirements in accordance with Sec 622.30.4, regardless of the segment's length. The engineer may require removal of unbroken fins at the contractor's expense.

(c) In excluded areas, smoothness requirements will be modified or may be waived by the engineer.

(d) The engineer may test for smoothness and bumps near the center line and at other spot locations where compliance is questionable. Additional grinding may be required. The provisions under Sec 502.8.6 will not apply.

(e) The original and final profilograph traces shall not be used to determine grinding depth.

622.30.5 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, measurement will be made to the nearest square yard (m²). Measurement will be based upon the full pavement lane width. No deduction will be made for gaps within the pavement lane to avoid striping, raised pavement markers, manholes or other structures.

622.30.6 Basis of Payment. The accepted quantity of ground pavement surface will be paid for at the contract unit price for diamond grinding concrete pavement. Payment will be considered full compensation for all labor, equipment, material and incidentals to complete this work, including hauling and disposal of grinding residue.

SECTION 622.40 DIAMOND GRINDING OF NEW PORTLAND CEMENT CONCRETE PAVEMENT

622.40.1 Description. This work shall consist of grinding new Portland cement concrete pavement to provide good riding characteristics and surface texture. The finished surface shall be as shown on the plans.

622.40.2 Equipment. The grinding equipment shall be in accordance with Sec 622.30.2.

622.40.3 Construction Requirements.

622.40.3.1 Paving. When diamond grinding is used as the final texturing for new Portland cement concrete pavement, concrete paving shall be in accordance with Sec 502, except as follows. All joints shall be protected to prevent grinding residue from entering. Joints to be

diamond ground shall be cleaned and sealed in accordance with Sec 502 after diamond grinding is completed.

622.40.3.2 Smoothness Requirements.

622.40.3.2.1 No diamond grinding shall be done until the pavement has attained a strength sufficient to be opened to all types of traffic, and no sooner than twenty one days after being placed. All diamond grinding shall be completed on any section prior to opening that section to other than construction traffic, unless approved by the engineer.

622.40.3.2.2 The final pavement surface from the grinding process shall be in accordance with Sec 622.30.3.7. All grooves and adjacent passes shall be parallel to each other and the roadway, with no variation. Adjacent passes shall completely lap with no unground surface between, however, they shall not overlap more than 1 1/2 inches (35 mm). Adjacent passes shall be within 1/8 inch (10 mm) of the same height as measured with a 3-foot (914 mm) straightedge. No less than 98 percent of the specified surface shall be textured by grinding. There shall be no ridge between lanes. Any remaining ridges on the outside edge next to the shoulder greater than 1/8 inch (10 mm) high shall be feathered out to the satisfaction of the engineer in a separate operation.

622.40.3.2.3 Any deficiencies in the final surface due to improper contractor operations or equipment shall be corrected by the contractor, at the contractor's expense.

622.40.3.2.4 The contractor shall remove and dispose of all residue from grinding operations in accordance with Sec 622.30.3.8.

622.40.4 Basis of Payment. No direct payment for diamond grinding new concrete pavement will be made. Diamond grinding new concrete pavement will be considered as part of the work paid for under the contract unit price for Portland concrete pavement in accordance with Sec 502.



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 and applying epoxy 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 web site.

Item	Section
Concrete	501
Concrete Bonding Compound and Epoxy Mortar	623
Gradation E Coarse Aggregate	1005
Type III Cement	1019
Type III Epoxy & Epoxy Polymer Concrete Overlay	1039
Water	1070

704.3 Types of Repair.

704.3.1 Repairing Concrete Deck (Half-Soling). This work shall consist of partial removal and replacement of bridge deck concrete in the required areas.

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.

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 concrete in the areas where the reinforcing steel is exposed. 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 (100 mm) 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 (100 mm) 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.

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.

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

704.4 Construction Requirements.

704.4.1 Removal Requirements. The type of repair and areas to be repaired will be outlined by the engineer. 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 (13 mm) 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.

704.4.1.3 Conventional Hand/Mechanical Equipment. Conventional hand/mechanical equipment consisting of jackhammers no heavier than the 35-pound (15.9 kg) class shall be used for concrete removal. For bridge decks rated 5 or below, the jackhammers shall not be heavier than the 65-pound (29.5 kg) class. Chipping hammers from the 15-pound (6.8 kg) 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.

704.4.1.5 Concrete Removal. A boundary perimeter with one-inch (25 mm) 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.

704.4.1.6 Reinforcing Bar Exposed. All exposed reinforcing bars shall be thoroughly cleaned by sand or hydro blasting to the satisfaction of the engineer.

704.4.1.6.1 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 (25 mm) beyond the inside edge of any exposed reinforcing bars, including the main reinforcement.

704.4.1.6.2 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, 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 (25 mm) clearance shall be maintained.

704.4.1.6.3 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 (25 mm) clearance shall be maintained.

704.4.1.7 Reinforcement Repair. Particular care shall be taken not to disturb or damage reinforcing bars. All exposed reinforcing bars shall be thoroughly cleaned by sand or hydro blasting. Cut or broken bars or bars with 10 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.

704.4.1.8 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 Patch Preparation Requirements. After removal of deteriorated concrete, the area to be repaired shall be sand or hydro blasted to remove all foreign matter, dirt, free standing water and loose material. 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 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 blasting. 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 (620 kPa).

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 (2.4 m²/L).

704.4.4 Placement of New Concrete.

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.

704.4.4.2 Concrete Requirements. Concrete for concrete deck repair shall be Class B-2, except 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 3200 psi (22 MPa). 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.

704.4.4.3 Bridge Decks with Cathodic Protection System. Concrete for repairing the concrete deck 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 (22 MPa). 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 (2.97 kg/m³). 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 (25 mm) 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 (2.97 kg/m³).

704.4.4.4 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.

704.5 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, repairing concrete deck (half-soling), deck repair with void tube replacement, slab edge repair, superstructure repair (unformed) or

modified deck repair. No duplication of measurement will be made for substructure repair, unformed and formed.

704.5.1 Repairing concrete deck (half-soling), deck repair with void tube replacement, full depth repair, modified deck repair, superstructure repair (unformed) and substructure repair (formed and unformed) will be measured to the nearest square foot (0.1 m²).

704.5.2 Slab edge repair will be measured to the nearest linear foot (0.5 m).

704.5.3 No measurement will be made for epoxy sealing.

704.6 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. No direct payment will be made for epoxy sealing.

