

SECTION 518 - BRIDGE DECK REHABILITATION

518.01 Description.

- A. Repair of Concrete Deck.** This work shall consist of the removal and disposal of loose and disintegrated concrete, the preparation of the surface, cleaning or replacement of existing reinforcement steel, application of epoxy bonding coat, and placing of concrete patch materials.
- B. Membrane Waterproofing.** This work shall consist of the placing of a waterproofing membrane on the surface of the existing bridge deck prior to placing an overlay of bituminous concrete.
- C. Concrete Deck Overlay Protective System.** This work shall consist of the construction of a concrete deck overlay protective system in accordance with Subsection 518.06 A.
- D. Scarification.** This work shall consist of scarifying existing concrete bridge decks prior to repair of concrete deck or placing of concrete deck overlay protective systems.

MATERIALS

518.02 Materials.

- A. Repair of Concrete Deck.** Class A concrete shall conform to Section 914. For all concrete deck repairs, the coarse aggregate shall be size No. 8. It shall be a maximum of 13 millimeters in size, not exceed 1/2 the thickness of section to be placed and be broken stone or crushed gravel.

Other materials shall conform to the following Subsections:

Coarse Aggregate.....	901.13
Epoxy Bonding Coat.....	912.24
Reinforcement Steel, Deformed Bars.....	915.01
Latex Emulsion Admixture.....	919.10
Silica Fume Admixture.....	919.10
Quick-Setting Patch Materials.....	919.12

A quick-setting patching material products list, from which a product may be selected for use in a project, will be provided in the Special Provisions. The Type classifications are in accordance with the descriptions provided in Subsection 919.12. The provisions of Section 919.12 shall be adhered to in selecting a product. Quick setting patching materials are only to be used for deck repairs on bridges where installation of a Concrete Deck Overlay Protective system is not scheduled. Additional products will be considered for approval only after testing by the Department Laboratory and evaluation in the field, in service under all kinds of weather conditions. An extension of Contract Time will not be allowed due to delays caused by or in any way related to such testing and evaluation by the Department.

Certification shall be furnished, in accordance with Subsection 106.04, in the product selection. The certification, shall state that the product meets the requirements of Subsection 919.12. Additionally, the Contractor shall verify, with the product supplier, that the quick setting patching material will satisfactorily perform in achieving the desired concrete deck repair.

When LMC overlay is specified, epoxy resin patching material shall not be used. Other patching material systems shall not be used if the coefficient of thermal expansion of the patching material system, as determined in accordance with ASTM C 531, is 25 percent greater or less than the coefficient of the LMC mix to be used in the overlay.

- B. Membrane Waterproofing.** A membrane waterproofing products list will be provided in the Special Provisions. Additional products will be considered for approval if they conform with the requirements of Subsections 919.05 and 919.19. Certification of compliance shall be furnished in accordance with Subsection 106.04 prior to approval. Membrane waterproofing shall conform to the properties of Subsection 919.05.
- C. Concrete Deck Overlay Protective Systems.** Materials shall conform to Subsection 501.02 and the following:
1. **Coarse Aggregate.** Coarse Aggregate shall comply with the requirements of Subsection 901.13, Item (A). Coarse Aggregate shall be size number 8 with a maximum 13 millimeter size, not exceed $\frac{1}{2}$ the thickness of section to be placed and be broken stone or crushed gravel.
 2. **Fine Aggregate.** Fine aggregate shall comply with the requirements of Subsection 901.13, Item (B).
 3. **Concrete Admixtures.** Admixtures shall comply with the requirements of Section 905, and AASHTO MI94.
 4. **Bonding Grout.** Bonding grout shall consist of equal parts, by volume, of portland cement and fine aggregate, mixed with sufficient water to form a slurry. The consistency of the slurry shall be such that it can be applied with a stiff synthetic bristle brush or broomed to the prepared surfaces in a thin, even coat that will not run or accumulate in pockets or depressions. Retempering shall not be allowed.
 5. **Curing Materials.** Wet burlap shall conform to Subsection 905.03.
 6. Refer to Subsection 518.06 for Concrete Deck Overlay Protective System Types. A list of supplies will be provided in the Special Provisions.

EQUIPMENT

518.03 Equipment.

- A. Concrete Overlay Protective System.** The equipment used to place the concrete shall comply with the requirements of Subsection 405.03, Item (A). The following criteria shall also be adhered to:
1. The equipment should provide positive control of the flow of water and admixture into the mixing chamber. Water flow should be indicated by flow meter and be readily adjustable to provide for minor variations in aggregate moisture. The admixture discharge pipe shall be readily accessible for determining proportioning accuracy.
 2. The placing and finishing equipment shall also conform with Subsection 405.03, Item (B)(4) and the following:
The machine must be able to span the entire placement transversely and shall be equipped with one or more rotating cylinders, augers and vibratory units (either rollers, cylinders or pans).
 3. The Contractor shall supply fog misting equipment which is capable of delivering 8 to 11 liters of water per minute at 13 megapascals to 17 megapascals using a 40 degree to 50 degree wide-angle nozzle or as approved by the Engineer. The Contractor shall notify the Engineer, in writing, 45 calendar days prior to concrete placement which model apparatus will be used.
 4. The operation of equipment or vehicles on or over the deck slab shall be in conformance with the requirements of Subsection 405.17. Runways shall be provided when concrete transporting devices are

expected to operate over exposed reinforcing steel. Vehicular traffic shall not operate on or over the overlay until the overlay has been sawcut grooved in accordance with Subsections 518.06 C.13.

5. The Contractor shall supply a continuous recording thermometer capable of recording ambient temperatures and the temperature of the concrete in the minus 1 degree to plus 38 degree C range. The thermometers shall provide a recording capability over a 24 hour continuous period. The Contractor shall provide any ancillary equipment, supplies and labor necessary for the calibration of this equipment.
6. Scarification equipment shall comply with the requirements of Subsection 518.03, Item (B).
7. A sufficient number of stiff nylon bristle push-brooms, nylon bristle straight brooms and pails shall be provided.
8. To ensure that the surface to be overlaid is damp and ready to receive the material, the equipment should be capable of spraying water over the entire placement width as it moves ahead.

B. Scarification. The equipment shall be self-propelled and capable of scarifying a minimum of 830 square meters per day across the cutting path in one pass to a minimum depth of 6 millimeters. It shall be capable of establishing profile grades by referencing from existing grades and shall have a means for controlling cross slopes.

The equipment shall have a means for removing milled material from the surface and for preventing dust and other materials from escaping into the air.

The equipment shall have a floating type head that allows for deeper cutting in areas of deteriorated concrete. It shall have the capability of locking out the head float.

Pneumatic and equivalent electric hammers, not heavier than nominal 14-kilogram class, and triple-headed tampers fitted with star drills not less than 50 millimeters in diameter may be used to remove concrete surfaces adjacent to curbs and scuppers.

C. Silica Fume Concrete Overlay. The overlay concrete shall be mixed by transit mixers only. The equipment used to place the concrete shall comply with the requirements of Subsection 405.03, Item No. 3. The following shall also be required for this work:

1. Bonding Grout Mixer. The mixer shall be the type designed for mixing mortar. It shall have a minimum capacity of 0.1 cubic meter. The mixer shall be approved by the Engineer prior to use.
2. At least 2 (two) batching boxes of 0.1 cubic meter capacity each shall be approved at the site for the proportioning of sand and cement.

D. Latex Modified Concrete Overlay. The overlay concrete shall be mixed by continuous mixing type truck mixers only. The equipment used to place the overlay concrete shall comply with the requirements of Subsection 405.08, Item No. 4, and the following:

1. They should be self-propelled and be capable of carrying sufficient unmixed dry, bulk cement, sand, coarse aggregate, Modifier A, and water to produce on the site not less than 4.6 cubic meters of concrete.
2. Mixers should be calibrated to accurately proportion the specific mix. Where placements involve more than 76 cubic meters, calibration of cement and latex should be checked at 76 cubic meter intervals. The yield will be required to be within a tolerance of 1.0 percent according to the following tests:

With the cement mixer set to zero and all controls set for the desired mix, activate the mixer, discharging mixed material into a 0.19 cubic meter container that is 0.914 m x 0.914 m x 0.228 m in size. When the container is level-struck full, and provision for setting the material into all corners is made, the cement meter must show a discharge of 7 bags/cubic meter of cement.

CONSTRUCTION

518.04 Repair of Concrete Deck.

Repairs of concrete deck are classified as follows:

1. Type A Repair shall consist of removing all delaminated and/or deteriorated deck concrete from 20 millimeters minimum to the top layer of the existing top reinforcement steel and placing of Type I quick-setting patch material to the level of the existing concrete deck or to the level of the scarified deck surface, if scarification is scheduled or directed.
Type A Repairs are to be used only by Department maintenance forces.
2. Type B Repair shall consist of removing all delaminated and/or deteriorated deck concrete to a minimum depth of 25 millimeters below the bottom of the top layer of existing reinforcement steel to a maximum depth of 50 percent of the thickness of the existing concrete deck and placing of Class A concrete or Type IA quicksetting patch material, whichever is specified, to the level of the existing concrete deck or to the level of the scarified deck surface, if scarification is scheduled or directed.
3. Type C Repair shall consist of removing all delaminated or deteriorated deck concrete for the full depth of the existing deck and placing Class A concrete or Type IA quick-setting patch material, whichever is specified, to the level of the existing concrete deck or to the level of the scarified deck surface, if scarification is scheduled or directed.

As per the criteria stated in Subheading 4 of the sixth paragraph of Subsection 405.14, in the use of a Type IA quick setting patch materials, the patched area shall be wet cured by covering with wet burlap immediately after complete placement and finishing of the material. The patched area shall be kept covered for a period of three (3) hours.

For those projects, where installation of a concrete overlay protective system is scheduled, spalled, delaminated or deteriorated concrete shall be repaired by placement of the concrete overlay material type that is to be used or by placement of Class A concrete. The provisions of Subheading 2 below shall be followed.

Prior to commencement of concrete removal, a field survey shall be performed for each stage of construction for the purpose of establishing existing grades and cross slopes and for determining proposed finished grades and cross slopes. The cross slopes where given on the Plans are theoretical and approximate and are not intended to be actual.

A minimum of three deck elevations in each span shall be taken for each stage of construction, at the centerline of the bearings and centerline of span along each lane line and gutter line before proceeding with concrete removal or scarification.

The Contractor shall take additional field measurements that are necessary to establish existing grades or cross slopes and to develop finished grades and cross slopes in transition areas.

Repairs of concrete decks shall conform to the following:

- 1. Deck Preparation.** Written notice shall be submitted not less than 14 calendar days in advance of when the site is available for a deck condition survey by the Department. Surveys will be scheduled during daylight hours of working days unless the working time is restricted in the Contract Documents. Surveys will be performed only if the ambient temperature has been above 4 °C for a minimum of 72 hours prior to the beginning of the survey and only if the deck is dry. Lighting facilities shall be furnished and maintained for any survey work scheduled during the hours of dusk or darkness. In all cases, traffic controls required for the safe and convenient conduct of the survey shall be provided.

The deck condition survey will be made before scarification, if scheduled, and after the removal of any existing bituminous concrete overlay and waterproofing membrane. The survey may include, but not be limited to, the following procedures:

- a. visual inspection,
- b. coring samples for chloride analysis,
- c. delamination survey, and
- d. electrical-potential measurement (half-cell testing) as described in FHWA Report No. DP-84, "Corrosion Detection in Reinforced Concrete Bridge Structures".

The data obtained will be used to determine the repair limits which will be designated as promptly as conditions permit.

Prior to the start of the survey, the Contractor shall furnish a properly connected half-cell meter equivalent to an M.C. Miller Co. (Telephone: 201-728-3800) Model IA electronic potential meter with an intermediate electrode extension, a 762-millimeter PVC extension, 30 meters of 1.59-millimeter diameter wire, 470 milliliters of distilled water, a 100 by 150 by 25-millimeter sponge, and two alligator clips. The Contractor shall retain ownership of the meter and accessories upon completion of the Project.

- 2. Construction Procedures.** Repair areas shall be saw cut to a 20-millimeter depth prior to scarification, if scheduled, and prior to removal of deteriorated concrete in the designated areas.

During removal for Type C Repair, temporary shielding shall be provided to prevent debris from falling below the deck.

All loose and disintegrated concrete shall be removed from the areas to be repaired in such a manner and to such an extent as to expose a sound concrete surface. Sound concrete (beneath the disintegrated concrete) shall be removed for a depth of not less than 6 millimeters and not more than 25 millimeters, and the remainder of the area and all exposed reinforcement shall be cleaned and roughened by sandblasting. The work shall be done in such a manner as not to damage the concrete that is to remain.

Removal of concrete or preparing and shaping areas to be repaired may be performed by power chipping or hand tools, except that pneumatic hammers heavier than nominal 14-kilogram class (15 kilograms maximum) will not be permitted. Pneumatic hammers and chipping tools shall not be operated at an angle exceeding 45 degrees relative to the surface of the deck slab. Such tools may be started in the vertical position but must be immediately tilted to a 45-degree operational angle. Pneumatic hammers heavier than nominal 7-kilogram class (9 kilograms maximum) will not be permitted for chipping areas directly below the top longitudinal reinforcing steel or in areas adjacent to primary girder reinforcement steel, such as stirrups in prestressed concrete girder configurations.

Technical data sheets for pneumatic hammers intended for use shall be submitted at the preconstruction meeting for approval.

Hand chipping methods shall be used to remove concrete adjacent to exposed reinforcing steel. Care shall be taken so as not to damage or debond the reinforcement steel, or to shatter the concrete beyond the area to be repaired.

For Types B and C Repair, all corroded reinforcing bars shall be cleaned by sandblasting, waterblasting, or wire brushing. Those bars that have lost 25 percent or more of their original cross-sectional area shall be supplemented by splicing in new epoxy-coated reinforcement steel of the same diameter. In supplementing existing bars, they shall be lapped at least 30 bar diameters and wired together. If necessary, additional chipping of concrete shall be done to provide for this lap. Where reinforcement is broken or missing, new bars shall be lapped at least 30 bar diameters on each side of the break. For Type A Repair, where the bond between existing concrete and reinforcing steel has been destroyed, or where more than half the diameter of the steel is exposed, the concrete adjacent to the bar shall be removed to a depth in accordance with a Type B Repair. A minimum of 25 millimeters clearance around the bar is required except where lower bar mats make this impractical. In the concrete removal operation, if the epoxy coated reinforcement is damaged, the reinforcement shall be repaired in accordance with AASHTO M 284 at no cost to the Department.

In areas of Type C Repair, forms shall be provided to enable placement of the concrete or quick-setting patch material. These forms may be suspended from existing reinforcing bars by wire ties for small areas, and in the case of large area openings, they shall be supported by blocking from the beam flanges.

The sides of the concrete at the location of Type C Repair shall be inclined so that the top area of the repair is larger than the bottom.

When Class A concrete is specified for Types B and C Repair, all operations shall conform to the applicable provisions of Section 501 and the following:

- a. An epoxy bonding coat shall be applied to the surface of sound concrete in the repair area just prior to placing the Class A concrete. The epoxy bonding coat shall not be allowed to completely dry prior to the placement of the Class A concrete. In order to assure a proper bond, the consistency of the coating shall be tacky to the touch. If the coating has completely dried, it shall be roughen, by whatever means chosen by the Contractor, to the satisfaction of the Engineer. The epoxy bonding coat shall then be reapplied.
- b. Traffic, equipment, or other loading will not be permitted on the deck slab when Class A concrete is used as a patch material until the concrete has cured 72 hours and the minimum strength for an additional individual test as defined in Section 914 exceeds 28 megapascals from two cylinders cast during placement. When Class A concrete is used, the repair areas shall be cured in accordance with the provisions of Subsection 518.06 C.12, for the 72 hour period. An air cure period will not be required.

When installation of a concrete overlay protective system is scheduled, all existing patched areas shall be completely removed prior to placement of the overlay.

When quick-setting patch materials are specified for Type A, B, or C Repair, all operations shall conform to the manufacturer's recommendations. Two copies of the manufacturer's technical data sheets shall be submitted at the preconstruction meeting. A technical representative of the manufacturer shall be present on the site to provide guidance in the preparation and placement of the

quick-setting patch material based on prevailing climatic and job conditions. The representative shall be present at least during one complete cycle of the procedures required for the initial placement.

When a concrete overlay protective system type is used for deck repairs, the repair areas shall be brushed with a thin layer of the overlay material that is to be used to complete the overlay. The material shall then be placed, spud vibrated and compacted by hand methods to fill the repair areas. Upon completing the repairs, the areas shall be cured in accordance with the provisions of Subsection 518.06 C.12. for a period of 72 hours. An air cure period will not be required. The provisions of Subsection 518.06 shall be followed for the installation of the overlay.

When an existing concrete overlay protective system is to be repaired, the same overlay type material shall be used to complete the repairs. Adequate measures, to the satisfaction of the Engineer, shall be used to remove the deteriorated overlay areas. The repair areas shall be brushed with a thin layer of the overlay material. The material shall then be placed, spud vibrated and compacted by hand methods to fill the repair areas. The repaired areas shall be cured in accordance with the provisions of 518.06 C.12 for a 72 hour period. An air cure period will not be required.

518.05 Membrane Waterproofing.

- A. Deck Preparation.** Repair of concrete deck shall be performed in accordance with Subsection 518.04. The repairs shall be completed and accepted prior to installation of the membrane waterproofing.
- B. Construction Procedures.** Requirements for cleaning and surface preparation of concrete on the existing bridge deck slabs, construction equipment, temperature and weather conditions, application of primer, and other operations pertaining to placing the membrane waterproofing may vary with the proprietary product. Two copies of the manufacturer's technical data sheets shall be submitted at the preconstruction meeting. Construction shall be done in strict conformance to the manufacturer's recommendations. The manufacturer's technical representative shall be on the site for the first full day of the initial construction to recommend methods for surface preparation, priming, and installation of the membrane waterproofing based on prevailing climate and job conditions.

518.06 Concrete Deck Overlay Protective Systems

- A. Concrete Deck Overlay Protective Systems.** The Contractor may select one of the following concrete deck overlay protective systems for the second course deck construction. The concrete shall be uniform in composition and consistency and shall conform to the mix design requirements stated below. Mixing capability shall be such that placing and finishing can be accomplished in one continuous operation without any delay before the formation of the plastic surface film. In accordance with AASHTO T23, a minimum of four test cylinders for compression testing will be made for each day's placement for each mixer unit. This is with the exception that the demolded cylinders are to be air cured.

At least 45 calendar days prior to the planned start of the overlay placement, a mix design shall be submitted for approval and verification. Verification and approval of the design mix shall include testing properties that are specified for the overlay. Compressive strength testing requirements shall be 28 megapascals at 28 days. Trial batches shall be prepared of the same materials and proportions required by the mix design that has been submitted for approval and verification. Department personnel will be present during verification batching to ensure that

the proportions and ingredients batches are in accordance with the proposed mix design. At least three tests (six cylinders) for compression testing shall be prepared, cured, and delivered in accordance with AASHTO T 23 or AASHTO T 126, except that the demolded cylinders shall be delivered to the Department laboratory where they will be tested for a 7 and 28 day compressive strength.

- 1. Latex Modified Concrete.** Certification shall be furnished, in accordance with Subsection 106.04, that the manufacturer of the latex emulsion admixture has verified the compatibility of the proposed cement to be used in the LMC mix.

The latex modified concrete shall have the following design mix:

DESIGN MIX CRITERIA

Cement, bags per cubic meter (42.7 kilogram bag)	9.16
Latex emulsion admixture, liters per bag	13.2
Water, liters per bag	10.2 max
Air content, percent of plastic mix	
according to AASHTO T 152	6.5 max
Slump, millimeters (see note 2).....	75 to 150 max
Percent fine aggregate in accordance with content of total	
aggregate, by weight	55 to 70
Weight ratio range (dry basis):	
cement	1.0
sand	2.5 to 3.1
coarse aggregate	1.4 to 2.0
Design Strength @ 28 Days	Class A, Table 914-3
Verification Strength @ 28 Days	Class A, Table 914-3

NOTE 1. The net water added shall be adjusted to control the slump within the prescribed limits and should produce net water-cement ratios of 0.30 to 0.40 by weight.

NOTE 2. The slump will be measured four to five minutes after discharge from the mixer. LMC shall not be placed during this waiting period.

NOTE 3. The dry weight ratios are approximate but, due to gradation changes or variable specific gravities, may be adjusted by the Engineer within the weight ratio ranges.

- 2. Silica Fume Concrete.** The mix design shall include the sources of fine and coarse aggregates and the composition of silica fume admixture such as fineness, silica content, total chloride ion content, solids content for slurries and moisture content for powders.

Certification shall be furnished, in accordance with Subsection 106.04, that the manufacturer of the silica fume admixture has verified the compatibility of the proposed cement to be used in the silica fume concrete mix.

The silica fume concrete for the bridge deck overlay shall have the following design mix:

DESIGN MIX CRITERIA

Minimum Cement Content (Kg/m ³)	387 +/- 6
Silica Fume Content	7% +/- 0.5%
	of total cementitious content
Water/Cementitious Ratio (See Note 1)	0.40
Fine Aggregate (% of Total Aggregate by Weight)	54 +/- 2
Coarse Aggregate (% of Total Aggregate by Weight)	46 +/- 2

Air Content %	7. +/- 2
Slump (See Note 2) (MM).....	152 +/- 50
Design Strength @ 28 Days	Class A, Table 914-3
Verification Strength @ 28 Days	Class A, Table 914-3

Note 1: This represents the total quantity of water required. If a silica fume slurry is used, the slurry water shall be included in the calculation as a mix water. The free moisture content of both the fine and coarse aggregates shall be included in the calculation as mix water. Retempering with water is not permitted.

Note 2: A Type F or Type G high range water reducing admixture shall be added to provide a slump within the allowable range. It shall be added at the plant and/or project site, using a method approved by the Engineer. Additions of admixtures at the site shall not exceed two in number and the total quantity from all additions shall not exceed the manufacturer's maximum dosage rate. Each time the admixture is added at the work site, the concrete shall be mixed an additional minimum 30 (thirty) revolutions. Upon successful trials, as exhibited by consistent slump and air content results, the Engineer may allow the high range water reducing admixture to be added at the concrete batching facility. Regardless of where the high range water reducing admixture is added, the total number of the mixer's revolutions shall not exceed 160 (one hundred sixty).

Certification shall be furnished, in accordance with Subsection 106.04, that the manufacturer of the admixture has verified the compatibility of the proposed cement to be used in the overlay mix.

The net water added shall be adjusted to control the slump within the prescribed limits and should produce net water-cement ratios of 0.30 to 0.40 by weight.

The slump will be measured four to five minutes after discharge.

The concrete shall not be placed during this waiting period.

The dry weight ratios are approximate but, due to gradation changes or variable specific gravities, may be adjusted by the Engineer within the weight ratio ranges.

B. Quality Assurance Verification. In accordance with AASHTO T 277, permeability testing to document the quality of the concrete overlay material shall be performed at 28, 56 and 90 day intervals. At least 45 calendar days prior to the planned start of the overlay placement, a Report to include laboratory data to document completed results of permeability testing shall be submitted. The permeability samples used for this testing shall be cylindrical samples with a 100 millimeter diameter and at least 100 millimeters in length. They shall be moist cured in the same manner as the strength cylinders. The test value shall be the result of the average value of tests on two specimens from each batch.

The results of the AASHTO T 277 testing shall be correlated with the results of a 90 day ponding test that shall be performed in accordance with AASHTO T 259. The completed results of the 90 day ponding test shall also be included in the Report.

The Contractor shall also submit six (6) additional cylindrical samples to the Department Laboratory for performance of the AASHTO T 277 test by the State.

C. Furnishing and Installation. Furnishings and installation of a concrete deck overlay protective system shall conform to the following criteria:

1. Storage of Materials. When the concrete materials are stored on the Project site, they shall be maintained in accordance with Subsection 405.07.

Admixtures shall be stored in enclosures which can protect them from freezing or from prolonged exposure to temperatures in excess of 30 degrees C. The manufacturer's recommendations shall be followed.

2. Definitions.

a. **Curing Hour.** A curing hour is defined as any hour, beginning with the hour of placement, during which the ambient air temperature at the concrete surface remains at or above 10 degrees C, as measured by a recording thermometer.

b. **Curing Temperature.** This shall be the air temperature between the concrete surface and its protective covering.

3. Design Control and Acceptance Testing. Design control and acceptance testing shall conform with the requirements of Subsection 914.02. Verification strengths, slump requirements and air entraining percentages shall conform with Table 914-3 Mix Design Requirements.

4. Stockpiling Aggregates. Aggregate stockpiles shall be maintained in accordance with the requirements of Subsection 901.02.

5. Construction Plan. At least 30 days prior to the proposed start of placement of the overlay, the Contractor shall submit a plan for the construction of the overlay for approval by the Engineer. The written plan shall include the following:

- a. The proposed method of operation
- b. Equipment descriptions
- c. Number of mixing trucks to be used
- d. A plan for discontinuing placement and protecting the overlay during unfavorable weather conditions
- e. Contingency plans for interruptions of pours, work schedules, limits of pours
- f. Traffic vibration mitigation
- g. List of material's suppliers
- h. Knowledge level of Contractor's or Subcontractor's work force
- i. Maintenance and protection of traffic

At the time of submission, the Contractor shall request a pre-overlay meeting with the Engineer to discuss the written plan. The plan should demonstrate the ability of the Contractor to place, finish, texture, and cover the overlay within thirty minutes of placement on the deck and in accordance with the equipment and manufacturers' recommendations.

6. Surface Preparation. The following procedure shall be followed in preparing surfaces that are to receive the concrete overlay:

- a. Prior to commencement of concrete removal, and again on the finished surface after completion of the overlay, a field survey shall be performed by the Contractor to establish existing, proposed, and actual finished grades and cross slopes. A minimum of three deck elevations at the centerline, along each lane line and along the gutter line, at

the same location of each span, shall be taken for each stage of construction. The Contractor shall take additional field measurements necessary to establish existing grades or cross slopes and to develop and document finished grades and cross slopes in transition areas.

- b. Within a 48 hour period prior to placing the overlay, the entire surface that is to receive the overlay shall be cleaned by wet sandblasting, shrouded dry sandblasting with dust collectors, shot blasting, or high pressure water blasting to remove any loosened chips of concrete, curing compound, laitence, oil or any other residue that may impede the bonding of the overlay to the concrete substrate. All cleaning equipment shall be approved by the Engineer. Air supplies for all cleaning operations shall be equipped with an oil trap in the air line and shall supply air free from oil that may contaminate the deck surface. When high pressure waterblast is used, the pressure of the water shall be a minimum of 34 megapascals and shall be capable of producing the desired results.
- c. All reinforcing steel, or other steel which will be in contact with the new overlay shall be cleaned of all grease, dirt, concrete mortar and injurious rust. Injurious rust shall include all scale, loose rust deposits, or all rust not firmly bonded to the steel. Rust and concrete deposits, which in the Engineer's opinion cannot be removed by surface cleaning, shall be considered firmly bonded and may remain.
- d. The cleaned deck surface shall be protected by covering all surfaces to receive the overlay with a 6 mil minimum thickness, polyethylene film, until the overlay placement is to begin. If more than 48 hours elapse from the termination of surface cleaning operations to beginning of the overlay placement, then a second stage surface cleaning will be required regardless of the apparent condition of the receiving surfaces.
- e. If in the Engineer's opinion, contaminants, which might interfere with bonding, are present on the prepared surface, a second stage surface cleaning shall be performed. This shall be done in areas directed by the Engineer. A light coating of orange colored rust, that forms on the exposed existing reinforcing steel after first stage surface cleaning, is not considered detrimental to bond. It may remain unless the time limit stated above is exceeded, or if ordered to be removed by the Engineer.
- f. Immediately prior to placing the overlay, the cleared surface shall be thoroughly wetted for a period of not less than one hour. Any standing water in depressions, holes, or areas of deteriorated concrete removal shall be blown out with compressed air that is equipped with an oil trap.

7. Silica Fume Concrete Overlay. In the installation of a silica fume concrete overlay, the following shall apply:

- a. **Bonding Grout Application.** After the surface has been cleaned and prewetted, immediately before placing the overlay concrete, a thin (approximately 3 millimeter) coating of bonding grout shall immediately be vigorously and thoroughly broomed or brushed onto the saturated surface-dry prepared surface. All surfaces to be in contact with the silica fume overlay, including the slab, curb, longitudinal and transverse joints shall be coated with the bonding grout.

The bonding grout shall be applied with a stiff, synthetic bristle brush or broom. At all joints brooming shall be done with straight brooms. Care shall be exercised to ensure that all prepared surface areas receive a thorough, even coating, and that no excess bonding grout be permitted to collect in pockets. This shall be done to ensure that the bonding grout is evenly absorbed into the prepared surface.

The rate of bonding grout application shall be limited to the surface area which can be covered with the new concrete overlay before the bonding grout begins to dry out (typically 0.9 meters to 1.2 meters directly in front of the paver). Time limits will depend on atmospheric conditions and will be determined by the Contractor at the site. If the Engineer has determined that drying has occurred, the Contractor shall remove the bonding grout and place new bonding grout. Bonding grout removal shall be by sandblasting, waterblasting, or removed by other means approved by the Engineer.

No bonding grout mixing or placement will begin until the Engineer has approved all surface cleaning operations. The bonding grout shall consist of equal parts, by volume, of portland cement and fine aggregate, and shall be mixed with sufficient water to form a slurry.

- b. **Bonding Grout Mix.** Bonding grout shall be thoroughly mixed at the site, in a well lit area, in an approved mechanical mixer. The fine aggregate and cement shall be measured in separate 0.028 cubic meter batching boxes. The fine aggregate and cement shall be dry mixed for one minute and then water shall be added to form a slurry. Mixing will continue for a minimum of three minutes following the introduction of water. The Engineer may require that the mixer be cleaned after each batch.

If bonding grout has dried or become unworkable, as determined by the Engineer, it shall not be incorporated in the work. Norettempering will be permitted.

8. Latex Modified Concrete Overlay. In the installation of a latex modified concrete overlay, the following shall apply:

- a. Latex modified concrete shall be brushed onto the wetted prepared surface. All vertical and horizontal surfaces shall receive a thorough even coating.
- b. The brushed material shall not be allowed to become dry before placement of the overlay concrete. Brushed

material, as directed by the Engineer, that is not useful shall be disposed of and replaced.

- c. Stones that accumulate as a result of the brushing operation shall be disposed of.

9. Joints. The location of construction joints shall be as prescribed or directed. A bulkhead of Styrofoam or other approved material shall be installed at each deck joint to the required grade and profile prior to placing the concrete overlay.

10. Placing and Finishing. Placing and finishing shall conform to the following:

- a. Traffic on the structure being overlaid shall be restricted as specified in the Plans or elsewhere in these Specifications. Bumps, potholes, or other defects or conditions on the bridge deck surface including the approaches, that might, under traffic, produce vibration on the structure on which the overlay is being placed, shall be patched or repaired prior to the placement of the overlay.
- b. The finishing machine shall make a dry run over the entire bridge deck area to assure that the minimum thickness of prescribed overlay is attained.
- c. The overlay placement shall be continuous. Where delays occur due to sudden inclement weather, equipment failure, insufficient equipment or labor, disruption in material supply, or other conditions, a temporary bulkhead or joint shall be installed and placement shall stop. The Contractor shall provide a sufficient amount of approved covers for the protection of the overlay in the event of delays. Before resuming the overlay placement in the area of the joint or bulkhead, a 48 hour wet curing period must be completed, and the entire surface area including the vertical surfaces of the joint shall be cleaned. A new edge shall be sawcut a minimum of 150 millimeters back from any defect in the surface. Sawcutting the new edge shall not be done before the end of the two-day wet curing period. In no case shall the sawcutting or removal be permitted to damage the overlay that is to remain. To prevent drying, the Engineer may permit mitigation of unavoidable delays of up to 15 minutes by placing wet burlap over the fresh, unfinished concrete.
- d. As per the conditions stated in Subpart 11 below, fog misting shall begin immediately after placement and shall continue after the finishing operation until the placement of wet burlap.
- e. The overlay admixture manufacturer shall supply guidance to the Contractor and/or the subcontractor concerning finishing and handling of the concrete. The manufacturer shall have ACI certified concrete technicians on the site for the full day of the initial construction. Recommended methods and operational techniques based on prevailing climatic and job conditions shall be provided.
- f. The concrete shall be placed and struck off to approximately 5 millimeters above final grade. It shall

then be consolidated and finished to the final grade by the finishing machine.

- g. Spud vibration shall be required in deep pockets, edges, and adjacent to joint bulkheads. Hand finishing with a float may be required along the edge of the placement or on small areas of repair. Edge tooling is required at joints except next to metal expansion dams, curbs, and previously placed lanes.
- h. A portable lightweight or wheeled work bridge shall be used behind the finishing operation for touchup work, surface texturing, and curing cover placement.

11. Weather and Temperature Restrictions. The concrete overlay shall not be placed at air temperatures lower than 10 degrees C. It can be placed at 10 degrees C and rising, provided that the air temperature is forecast to remain above 10 degrees C for the first 12 hours of the curing period.

If it is probable that the air temperature could fall below 2 degrees C at any time during the planned placement or wet cure period, at least 30 calendar days prior to the scheduled placement, a plan of action for cold weather concreting, as defined in Subsection 501.11, shall be submitted for approval.

Unless provisions are made by the Contractor to reduce the atmospheric evaporation rate below 0.75 kilograms per square meter per hour, placement of the concrete overlay will not begin. Additionally, placement of the concrete overlay will be discontinued when the air temperature begins to exceed 30 degrees C or when the evaporation rate begins to exceed 0.75 kilograms per square meter per hour. The evaporation rate will be as determined with the use of a nomograph. The publication ACI Committee 305, "Recommended Practice for Hot Weather Concreting" (ACI 305 R-91) may be referred for guidance). The Contractor shall procure the nomograph.

Fog misting, wind shields, or other methods approved by the Engineer may be used to keep the evaporation rate below 0.75 kilograms per square meter per hour. If fog misting is used, the fog misting equipment shall be capable of delivering 8 to 11 liters of water per minute at 13 megapascals to 17 megapascals using a 40 degree to 50 degree wide-angle nozzle. The fog nozzle shall be held 1.8 meters above the concrete surface. Fog misting is not to be used to apply water that is to be worked into the surface of the concrete for finishing purposes. Fog misting will immediately be ceased if any water accumulation occurs on the surface. When required, fog misting will continue until the concrete has reached its initial set or in all cases to where the application of wet burlap will not damage the surface of the overlay. The Contractor shall notify the Engineer, in writing, 45 calendar days prior to the concrete placement, which model apparatus he proposes to use.

The measurements for air temperature, relative humidity, and wind speed shall be taken at the location of the concrete placement. Concrete temperatures shall be taken from the sample used for slump and air content tests. These measurements and calculations shall be performed at least once per hour beginning with the initial concrete placement and whenever, in the opinion of the Engineer, changes in

atmospheric conditions merit. The Contractor shall supply all the instruments necessary to take these measurements, subject to approval by the Engineer, including two battery operated psychrometers, two concrete thermometers, and two wind gauges. These instruments shall become the property of the Contractor after Acceptance. All instruments shall be certified by an independent laboratory that has been approved by the Engineer. The instruments shall be certified to be in good working order and as having been calibrated within the two months immediately prior to use. No separate payment shall be made for providing these instruments.

Placement will not begin and placement will be discontinued in the event of rain. The Contractor shall provide a sufficient number of approved covers and take adequate precautions to protect freshly placed concrete from rain. The Resident Engineer may order the replacement of any material damaged by rain.

If overlays are placed at night or during early morning hours, such work shall be illuminated to provide a safe working environment and to provide sufficient light to achieve the required quality of work. Lighting will be subject to the approval of the Engineer.

- 12. Curing.** After completion of the overlay placement and finishing, the entire overlay surface shall be completely covered with clean, wet burlap. The burlap shall be lapped a minimum of 300 millimeters and have been presoaked for a minimum of 24 hours and shall be drained of excess water prior to its application. The burlap shall be kept continuously wet and shall be protected from displacement and the Contractor shall take measures to ensure that the burlap lays flat in a manner acceptable to the Engineer. Lapped edges are not required to be sealed.

Failure to apply wet burlap within 15 minutes after concrete overlay placement shall be cause for rejection of overlay work as determined by the Engineer. Within one hour of covering with the wet burlap, a layer of white polyethylene sheeting, 150 micrometers minimum thickness, shall be placed on top of the wet burlap.

The burlap shall be kept wet for a continuous period of seven (7) calendar days by either a continuous wetting system or an intermittent sprinkler as approved by the Engineer. The removal of burlap at the end of the wet curing period shall be done late in the day so as to reduce the thermal shock to the overlay.

The overlay shall then be air cured for an additional seven calendar days.

The Contractor shall inform the Engineer of the intended curing procedure 30 days prior to the overlay placement.

- 13. Saw Cut Grooving.** After completion of the minimum total curing time of fourteen (14) calendar days, the overlay shall be grooved in accordance with Subsection 501.15, Item 3, provided that the concrete has attained a strength of at least 28 megapascals as determined from cylinders cast during the placement. Construction equipment needed for saw cutting the overlay will be permitted to operate on the overlay. Saw cutting equipment that is to be used shall not overstress the concrete deck or the overlay.

- 14. Deck Surface Tolerance Requirements.** Testing for deck surface tolerance requirements during placement of concrete overlay shall be in accordance with Subsection 501.16.
- 15. Opening to Traffic.** Vehicular traffic of any kind shall not be permitted on the overlay excepting that as specified above in Subpart 13. above for saw cutting operations. This shall be until the minimum curing period has elapsed and then only on the condition that test cylinders made at the time of placement have a minimum compressive strength of 28 megapascals. In the event that the 28 day cylinders fail to produce a compressive strength of 28 megapascals, the Engineer may order that the overlay be removed, replaced and tested for acceptance, all at no cost to the Department.
- 16. Limitation of Operations.** Actual placement of the overlay shall be performed as directed by the Engineer with consideration of traffic loads and vibrations.
- 17. External Heat Provisions.** If the Contractor elects to maintain curing temperatures by this method, he shall furnish sufficient canvas and framework, or other type of housing, to enclose and protect the concrete slab in such a way that the air surrounding the fresh concrete overlay can be kept at a temperature range of between 7 degrees C and 29 degrees C for the specified curing period. Any time in which the curing temperature falls between 0 degrees C and 7 degrees C will not be counted as curing hours. At the end of the curing period, the heat shall be gradually reduced at a rate not to exceed one half degree per hour until the temperature within the enclosure equals the temperature outside the enclosure.
- Enclosures used for overlay pours must completely enclose the existing slab on all five sides. There shall be sufficient room between the top of the existing slab and the top of the enclosure to allow placement of concrete overlay by any normal means.
- External heat shall be provided by means of stoves, salamanders, or steam equipment supplied and operated by the Contractor at its expense. Sufficient equipment shall be supplied to continuously maintain the specified temperatures of fresh concrete overlay to compensate for the accumulation of carbon monoxide gas.
- All exposed concrete overlay surfaces within the heated area shall be kept wet during the heating period unless heat is supplied in the form of live steam.
- Materials and equipment necessary to erect the enclosures and provide external heat shall be present on the job site and approved by the Engineer 30 days before any concrete overlay is placed.
- Heating appliances shall not be placed in such a manner as to endanger formwork or expose any area of concrete overlay to drying out or injury due to excessive temperatures.
- Temperature limits shall be maintained for seven (7) calendar days.
- Continuous wetting will not be required. However, the burlap shall be kept wet by wetting at regular intervals in a manner satisfactory to the Engineer.
- Enclosures for heat retention shall be properly vented to prevent surface disintegration due to carbonation.

D. Acceptance Testing.

After the total curing period has been completed, the overlay will be visually inspected for cracking or other damage. A delamination survey to verify bonding between the overlay and substrate after the overlay construction shall be performed. Before this survey is performed, the Contractor shall clear the survey area of all construction equipment, operations, and debris and clean the area by using compressed air or an equivalent method. Adequate traffic control shall be maintained during the bridge deck survey. The survey will be scheduled during the daylight hours of working days (and not less than five calendar days after the concrete overlay has been placed in any span). The Engineer will arrange for the performance of this survey by the Department.

Surface cracks not exceeding 10 millimeters in depth shall be sealed with a low viscosity epoxy sealer or a low viscosity methacrylate monomer penetrating sealer which is to be approved by the Engineer. Cracks exceeding 10 millimeters in depth shall be repaired by methods approved by the Engineer, or the affected portion of the overlay shall be removed and replaced. Delaminated or unbonded portions of the wearing surface or portions damaged by rain, other weather effects, or construction activity shall be removed and replaced. All corrective work identified above shall be at the Contractor's expense. Should the concrete overlay require this repair procedure, then the concrete overlay shall be tested and evaluated by petrographic examination at the Contractor's expense in accordance with the latest ASTM C856 specifications before any repairs are performed and after concrete repairs have been performed. The Contractor shall submit a certified copy of the test results from an independent testing laboratory to the Engineer.

The Engineer will be the sole judge in determining where the function and service of the deck may be impaired. Removal and replacement of the overlay or corrective actions shall be made in those areas prescribed by the Engineer before the deck slab will be considered for acceptance and opening to traffic. A plan for corrective action, describing the methods, equipment, and materials to be used, shall be submitted in writing for approval by the Engineer prior to beginning corrective action operations.

518.07 Scarification.

Provisions shall be made so that the existing transverse and longitudinal joints are not damaged below the limits of scarifications.

Saw cuts for repair of concrete deck, if scheduled, shall be completed in accordance with Subsection 518.04 before scarification. If, after scarification, other areas of deteriorated concrete are prescribed for repair beyond the initial saw cut peripheries, new saw cuts shall be made for the additional repair limits designated.

All concrete and other materials removed as a result of the scarifying operation shall be completely removed by hand, power broom, vacuum, or such other means, and disposed of. Flushing of this debris will not be permitted. Debris shall be removed at the end of each work day.

COMPENSATION**518.08 Method of Measurement.**

Repair of concrete deck of the various types will be measured by the square meter.

Membrane waterproofing will be measured by the square meter.

Concrete deck overlay protective systems will not be measured. The quantity of these overlays will be quantity in the proposal adjusted for change orders except as provided in