

Latex Modified Concrete Bridge Deck Overlay

Description. This work shall consist of the final surface preparation and construction of a latex modified concrete (LMC) or very early strength latex modified concrete (VESLMC) overlay, and shall include all labor, materials, and equipment necessary to perform the work in conformity with the plans and specifications.

Material. All material (where applicable) shall be in accordance with the state's respective specifications with regard to:

- Admixtures
- Coarse Aggregate
- Fine Aggregate
- Latex Modifier
- Polyethylene Sheeting
- Portland Cement (Type I, II, or III)
- Very Early Strength Mix (VES)*
- Water (potable)

*For VESLMC the latex manufacturer shall verify that the cement is compatible within the mix design.

Storage and Handling of Materials.

Coarse and fine aggregates shall be stored and handled to avoid contamination and maintain a uniform moisture content. Fine and coarse aggregates stored in piles or bins shall remain separated and covered with a moisture proof material which prevents variations in moisture content of the aggregates.

Cement shall be stored in weatherproof enclosures which protect the cement from dampness.

Latex admixture shall be stored in accordance with manufacturer's recommendations. It shall be kept in a suitable enclosure in a manner (such as an insulated tanker) that will protect it from freezing or exposure to temperatures in excess of 85 degrees F. Latex admixtures of different brands shall not be combined together.

Equipment. All equipment and tools necessary for handling materials and performing the work shall be approved by the engineer as to design, capacity, and mechanical condition.

Mixer.

A continuous volumetric type mobile mixer, calibrated to accurately proportion the specified mix, shall be used to mix and discharge the LMC.

The mixer shall be equipped with a flow meter for calibrating the water supply, and a cumulative-type meter that can be read to the nearest 0.1 gallon. The water meter shall be readily accessible, accurate to within 1 percent, and easy to read.

The mixer shall have a self-contained latex system on the unit with dedicated on-board tank, mechanization system (drive shafts or hydraulic), recirculation system, relief valve, pumps, strainers, control valves, pressure gauge and flow meters.

Continuous type mixers that entrap unacceptable volumes of air in the mix shall not be used. The latex manufacturers' recommended defoamer may be allowed to reduce the air content. Batch type mixers, drum-type transit truck type mixers, rotating drum batch type mixers, or concrete mobile mixers without the self-contained latex system, shall not be used for mixing the LMC. Mixers that cannot consistently produce a uniform, thoroughly blended mix, within the specified design parameters shall be replaced.

Placing and Finishing Equipment.

Placing and finishing equipment shall include a finishing machine, capable of covering large areas of work, which is self-propelled and capable of forward and reverse movement under positive control. Provisions shall be made for raising all screeds to clear the finished surface while traveling in reverse motion. The finishing machine shall consist of all appropriate finishing devices, including a vibrating pan, one or more rotating cylindrical rollers with augers or vibratory screed, drag pan, and wet burlap drag. The contractor shall provide all other hand tools necessary to distribute and strike off the latex modified concrete ahead of the finish machine.

At least two suitable lightweight wheeled work bridges will be required to aid in final finishing and curing of the LMC operation behind the finishing machine.

Proportioning. The contractor shall submit a mix design to the engineer for approval. The submittal shall include the name and location of aggregate suppliers, and the brand of cement and latex proposed for use. No concrete shall be placed prior to approval.

The latex modified concrete mixture shall contain the minimum proportions of these materials:

- Cement – 658 pounds per cubic yard (94 Lbs per bag)
- Latex Emulsion Admixture – 24.5 gallons per cubic yard
- Fine Aggregate – 210 to 255 pounds (50% to 60% by total weight) per bag of cement
- Coarse Aggregate – 168 to 208 pounds per bag of cement
- Net Water – 154 pounds per cubic yard

Properties of the latex modified concrete shall be as follows:

- Air Content – Zero to 7% maximum by volume of the plastic mix (Air entraining admixtures shall not be added). The use of the latex manufacturers' recommended defoamer may be allowed as needed.

- Slump – 3 to 7 inches (measured 4 to 5 minutes after discharge from mobile mixer). During the waiting period the concrete shall not be disturbed. For VES, slump of 6 to 10 inches.
- Water-Cement Ratio – Maximum 0.40 (0.42 for VES), considering all non-solids as part of the mixing water and free water in aggregates as a part of total water cement ratio.

Mixing. The concrete shall be volumetrically mixed at the bridge site by a self-contained, self-propelled, continuous type mobile mixer calibrated to accurately proportion the specified mix. Sufficient mixing capacity or number of mixers shall be provided to permit the intended pour to be placed without interruption. The mixer shall be capable of carrying enough quantity of unmixed ingredient to produce at least 6 cubic yards of LMC at the bridge site. The mixer should be equipped with a grounding strap.

The concrete discharged from the mixer shall be uniform in composition and consistency. The mixer shall also measure and control the flow of ingredients being introduced into the mix and shall record these quantities on a visible recording meter equipped with a ticket printer.

The flow of latex modifier shall be displayed by an approved flow meter. The latex system shall be equipped with a latex strainer to remove any solid particles during the operation of the mixer, and provide positive control of the latex emulsion into the mixing chamber. The mixer shall be capable of continuously circulating the latex emulsion. At any time, the engineer may request random one quart latex samples be taken for testing from tankers, or mobile mixers prior to placement on the deck.

Coarse and fine aggregates shall be conditioned to avoid variations in the moisture content affecting the uniform consistency of the concrete. Aggregate bins shall be clean, with sand bin vibrators in good working order.

Water flow shall be readily adjustable to compensate for minor variations in aggregate moisture content and be displayed by an approved flow meter.

The cement meter feeder fins and all pockets shall be clean and free of accumulated cement. The cement aeration system shall be equipped with a gauge or indicator to verify the system is operating.

The main belt, latex strainer, and the auger shall be kept free of accumulated build ups, partially dried, or hardened material.

Calibration. A complete calibration shall be performed for each mixer used at the work site prior to performing the work.

The mixer shall be set at the appropriate operating revolutions per minute as determined by the mixer manufacturer or mixer operator. Discharge the cement until an even flow of cement is achieved. It shall then be stopped and the cement meter reset to zero. A suitable container shall be set below the discharge of cement. The time required to discharge 94 pounds of cement shall be measured with a stop watch, the number of counts on the cement meter shall be recorded, and the weight of the discharged cement determined. The process shall be repeated at least three more times or until the trials have proved consistent with one another.

The following formulas shall be used to calculate the number of counts per 94 pounds of cement and the time required to discharge 94 pounds of cement:

$(\text{Total Counts} / \text{Total Weight}) \times 94 \text{ pounds} = \text{Counts per bag of cement} *$

$*\text{Counts per bag of cement} \times 7 = \text{Counts per cubic yard}$

$(\text{Total Time} / \text{Total Weight}) \times 94 \text{ pounds} = \text{Seconds per bag of cement}$

The accuracy of the water flow meter shall be verified by adjusting the flow to 2 gallons per minute. With the equipment operating at the required RPM's, the water discharged during a one minute interval shall be collected and weighed. The weight in pounds of the discharged water shall be divided by 8.33 to determine the number of gallons. This procedure shall be repeated with the flow meter adjusted to 3 gallons per minute. A theoretical water setting on the flow meter can be determined by calculating the total water required according to the mix design and then deducting for aggregate moisture and water in the latex emulsion.

Aggregate bin gates shall be calibrated based on the submitted mix design. Coarse aggregate and fine aggregate shall be weighed separately. The seconds per bag of cement for each mixer may be reduced by one half to reduce the aggregate weights to one half in order to provide a more manageable amount of material.

With the mixer set at the required operating RPM's, calibrate the delivery of the latex modifier into a suitable container. Mobile mixers must be equipped with a latex strainer before the latex is delivered to the auger for mixing. The latex strainer should be cleaned before each calibration and load of the of the mobil mixer. Making sure the strainer is unobstructed, the latex throttling valve shall be adjusted to deliver the required amount of latex emulsion admixture for each 94 pounds of cement. The weight of the latex shall be determined, and if necessary, the valve shall be adjusted such that the amount of latex discharged is within ½ pound of the amount required for each 94 pounds of cement.

Equipment shall also be required in accordance with the manufacturer's instructions for each specific admixture that may be required.

Yield Testing. Yield testing shall be performed during the placement of LMC on the deck using a ¼ cubic yard box (36" x 36" x 9"). The chute shall be clean of any LMC prior to discharge. The mixer shall be operated until the cement counter indicates ¼ cubic yard of concrete has been produced, and the contents consolidated and struck off. If the box is not full, the gates shall be adjusted and the procedure repeated until the actual and calculated volumes of concrete agree.

Yield tests shall be run on the first load of each truck and every third load per truck thereafter. Additional tests will be required after making any adjustments.

Blast Cleaning. Before the overlay is placed on a surface undergoing rehabilitation, the entire milled or hydrodemolished deck surface, and any related vertical surfaces, shall be thoroughly cleaned by a minimum 7500 psi waterblast or sandblasting. For new deck concrete, prior to overlay placement, the deck shall be shotblast, followed by a 7500 psi minimum waterblast; or a thorough sandblasting shall be performed that exposes the fine and coarse aggregates. The bonding surfaces shall be free of any laitance or foreign substance prior to the placement of the overlay.

The cleaned surface shall be thoroughly wetted to the point where it will not dry out (minimum of 1 hour, but potentially more depending on weather conditions), then covered with polyethylene sheeting until time of concrete overlay placement. It is imperative that the deck is damp at the time of overlay placement, but any standing water in depressions or areas of concrete removal within the deck shall be removed prior to placement and remain free of standing water. The surface shall remain wet upon completion of surface preparation and the overlay placed within 24 hours. If the deck is allowed to dry out, it shall be reblasted at the contractor's expense.

Placing and Finishing Equipment

Placement and Finishing Limitations. The contractor shall have three years' experience on similar size projects placing LMC.

The overlay shall not be placed unless the ambient temperature is 45 degree F and rising, or when the temperature is above 85 degrees F. When daytime temperatures exceed 85 degrees F, the contractor should consider placing the concrete during early morning hours or at night. If rain is expected, have materials and procedures in place to bulkhead or protect the overlay surface from damage. Areas damaged by rain shall be replaced at the direction of the engineer, at no additional cost to the agency.

In addition, LMC shall be placed only when the surface evaporation rate, as affected by ambient air temperature concrete temperature, deck temperature, relative humidity and wind velocity, is 0.1 pound per square foot per hour or less. The contractor shall determine and document atmospheric conditions. Refer to ACI 308 to determine graphically the loss of surface moisture for the overlay.

During delays in the overlay placement operation of more than 10 minutes or when a plastic film develops on the LMC, the work face of the overlay shall be temporarily covered with wet burlap. If an excessive delay is anticipated, a bulkhead shall be installed at the face and the overlay operation terminated.

Texturing. Immediately after acceptable finishing by machine and minor hand finishing, the surface shall be grooved by either acceptable post-cure mechanical methods or pre-cure texturing. When pre-cure texturing is performed, it shall be done transversely, immediately after finishing and before the plastic film forms, such that it does not tear the surface or bring coarse aggregate to the surface. Only tining rakes specifically designed for the purpose of concrete texturing shall be used and be in conformance with agency specifications. The tines shall be terminated approximately 18 inches from the vertical face of the curb or barrier. For post-cure texturing, mechanically saw cut grooving with a randomly spaced head is the preferred method. Post-cure texturing is suggested for VESLMC placement.

Curing. The surface of the overlay shall be promptly covered with a single, clean layer of wet (presoaked for 24 hours) burlap, as soon as the finished surface will support it and not cause marring or deformation. The total curing period shall be:

- LMC with Type I Cement: 2 days wet cure, 2 days dry cure
- LMC with Type III Cement: 1 day wet cure, 1 day dry cure

VESLMC:

Wet cure only until desired strength achieved (minimum 3 hours)

The burlap shall be kept continuously wet for the duration of the specified wet cure period. The wet burlap shall be promptly covered with opaque or white polyethylene sheeting for the entire duration of the wet cure. Curing mats shall then be removed following the wet cure period.

Method of Measurement. Bridge Deck Overlay shall be measured by the square yard of material for the specified thickness, as indicated on the plan documents.

Bridge Deck Overlay, Additional, is material used to fill surface irregularities, beyond the design plan quantity, and shall be measured by the cubic yard. The amount of material will be the difference between the total volume of material placed and the theoretical volume of bridge deck overlay calculated based on the plan documents.

Basis of Payment. Bridge Deck Overlay is paid by the contract unit price for the plan quantity indicated, at the specified thickness. Payment shall constitute full compensation for the placement and finishing of the theoretical plan thickness of the overlay, and include cost of all tools, equipment, labor or other incidental materials necessary to complete the placement of the LMC, including any other incidental work to complete this item.

Bridge Deck Overlay, Additional, is paid based on the actual cost of the materials as invoiced by the material supplier, or at a pre-determined unit bid price as set up in the contract, to as closely as possible capture the actual cost of the extra materials only.

Payment for bid items for Latex Modified Concrete Overlay will be made under:

Pay Item	Pay Unit
Bridge Deck Overlay.....	SQ YDS
Bridge Deck Overlay, Additional.....	CU YDS

No pay item is required for Bridge Deck Patching, Partial Depth. This work and material is included within the pay item Bridge Deck Overlay, Additional.