



**SPECIAL PROVISIONS
FOR
VERY HIGH EARLY STRENGTH LATEX MODIFIED CONCRETE OVERLAY**

**Emmet County
BRFN-015-4(18)--39-32**

**Effective Date
November 20, 2018**

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

150447.01 DESCRIPTION.

This specification consists of supplying, mixing, transporting, placing, finishing, and curing of Very High Early Strength Latex Modified Performance Concrete (VESLMC) for use as an overlay and riding surface in accordance with the Contract Documents and as directed by the Engineer. VESLMC is a cementitious material composed of granular constituents, a water-to-cementitious materials ratio less than 0.42 and a latex emulsion admixture.

150447.02 MATERIALS.

- A.** Provide materials in accordance with Division 41 of the Standard Specifications and as follows.
 - 1.** Coarse Aggregate – Use only those allowed in Article 4115.05 of the Standard Specifications.
 - 2.** Fine Aggregate – Use only those allowed in Section 4110 of the Standard Specifications.
 - 3.** Rapid Hardening Cement – Shall be approximately 33% calcium sulfoaluminate (C4A3S) and 67% dicalcium silicate (C2S) or other hydraulic cement that will provide a Latex Modified Concrete that meets the physical requirements of this specification. Fly ash or other pozzolanic materials are not permitted. Use a single source of cement for the project.
 - 4.** Latex Emulsion Admixture – Styrene butadiene in accordance with FHWA Report RD-78-35. Use a single source of latex for the project.
 - 5.** Other admixtures - Only as specified by the manufacturer.
- B.** The VESLMC mixture shall meet the material properties listed in Table 1: VESLMC Material

Properties, unless otherwise noted in the contract documents or as directed by the Engineer. Material properties listed below will be verified by the manufacturer and submitted for approval in the Placement Plan.

Description	Test Method	Acceptance Criteria
Compressive Strength <i>Ends of cylinders must be ground flush prior to testing. Saw cutting, capping, and use of neoprene pads are not permitted.</i>	AASHTO T22 (3" x 6" cylinders and 2" x 2" cubes) (150 psi/sec loading rate)	2500 psi at 3 hours, 3000 psi at 12 hours, 3500 psi at 24 hours, and ≥4500 psi at 28 days
Rapid Chloride Ion Penetrability	AASHTO T 277 / ASTM C 1202 (6 hour test)	≤ 1000 coulombs
Scaling Resistance	ASTM C672	Y < 2

The contractor shall submit a VESLMC 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 VESLMC mixture shall contain the minimum proportions of the following materials:

- Cement – 658 pounds per cubic yard (94 pounds 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 (1470 to 1785 pounds per cubic yard)
- Coarse Aggregate – 168 to 208 pounds per bag of cement (1176 to 1456 pounds per cubic yard)
- Net Water – 154 pounds per cubic yard. Net water shall be considered the quantity of mixing water added plus the non-solid portion of the latex.
- Admixtures containing calcium chloride shall not be used.

Properties of the latex modified concrete shall be as follows:

- Air Content – 0% 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 – 6 to 10 inches (measured 4 to 5 minutes after discharge from mobile mixer). During the waiting period the concrete shall not be disturbed.
- Water-Cement Ratio – Maximum 0.42, considering all non-solids as part of the mixing water and free water in aggregates as a part of total water cement ratio.

150447.03 CONSTRUCTION.

A. Storage.

Assure proper storage of all materials including but not limited to cement, aggregate, latex and additives, as required by the supplier's recommendation in order to protect the integrity of the materials against the loss of physical and mechanical properties.

B. Placement Plan.

1. Submit a Placement Plan with a detailed construction work schedule to the Engineer for review and approval at least 30 days prior to the scheduled VESLMC placement pour. The following list is intended as a guide and may not address all of the means and methods the contractor may elect to use. The Contractor is expected to assemble a comprehensive list of all necessary items for executing the placement of VESLMC.

- Responsible personnel and hierarchy.
- Equipment – including but not limited to mixers, holding tanks, generators, wheelbarrows, scales, meters, thermometers, floats, screeds, burlap, plastic, heaters, blankets, etc.
- Quality Control of batch proportions - including dry ingredients, latex, water and admixtures.
- Quality Control of mixing time and batch times.
- Batch procedure sequence.
- Form work – including materials and removal.
- Placement procedure – including but not limited to surface preparation of existing concrete surfaces and pre-wetting of the existing concrete interface to a saturated-surface-dry (SSD) condition before the placement of VESLMC, spreading, finishing, and curing protection. Include provisions for acceptable ambient conditions and batch temperatures and corrective measures as appropriate.
- Threshold limits for ambient temperature, ambient relative humidity, batch consistency, batch temperature, batch times and related corrective actions.

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.

2. A preconstruction meeting will be held between the VESLMC manufacturer's representative, the Contractor's staff, and representatives from Iowa DOT District Office, Office of Bridges and Structures, and Office of Construction and Materials to review the Contractor's Placement Plan prior to placement of VESLMC materials. No VESLMC pour will be permitted until the aforementioned Placement Plan has been submitted by the contractor and approved by the Engineer.
3. Pumping of VESLMC is not allowed.
4. Construction loads applied to the bridge during VESLMC placement and curing are the responsibility of the contractor. Submit the weight and location of concrete placing equipment, grinding equipment or other significant construction loads for review as part of the proposed Placement Plan.

C. Forming, Mixing, Transporting, Placing and Curing.

1. Forming.

Design and fabricate formwork if required to adhere to Standard Specifications and the recommendations of the VESLMC manufacturer. Construct forms from nonabsorbent material that are properly sealed and capable of resisting the hydrostatic pressures from VESLMC in the unhardened state. Do not remove formwork until the VESLMC overlay undergoes a minimum 3 hour curing process and the minimum desired strength gain of 3000 psi is achieved.

2. Mixing and Transporting.

- a. A continuous volumetric type mobile mixer, calibrated to accurately proportion the

specified mix, shall be used to mix and discharge the VESLMC. 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%, and easy to read.

- b. 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.
 - c. 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.
 - d. 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 (two minimum) shall be provided to permit the intended pour to be placed without interruption. The mixers shall be capable of carrying enough quantity of unmixed ingredient to produce at least 6 cubic yards of VESLMC at the bridge site. The mixer should be equipped with a grounding strap. Mobile mixers shall not be loaded more than 6 hours prior to placement.
 - e. 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.
 - f. 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 1 quart latex samples be taken for testing from tankers or mobile mixers prior to placement on the deck.
 - g. 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.
 - h. Water flow shall be readily adjustable to compensate for minor variations in aggregate moisture content and be displayed by an approved flow meter.
 - i. The cement meter feeder fins and all pockets shall be clean and free of accumulated cement.
 - j. The cement aeration system shall be equipped with a gauge or indicator to verify the system is operating.
 - k. The main belt, latex strainer, and the auger shall be kept free of accumulated build ups, partially dried, or hardened material.
 - l. A complete calibration shall be performed for each mixer used at the work site prior to performing the work in accordance with Materials I.M. 534. Equipment shall also be required in accordance with the manufacturer's instructions for each specific admixture that may be required.
- 3. Yield Testing.**
- a. Yield testing shall be performed during the placement of LMC on the deck using a 1/4 cubic yard box (36 inches by 36 inches by 9 inches). The chute shall be clean of any LMC prior to discharge. The mixer shall be operated until the cement counter indicates 1/4 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.
 - b. 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.

4. Placement.

- a. The contractor shall provide documentation of having successfully placed a VESLMC overlay meeting this specification on at least three projects of similar size and scope within the last 5 years. Submit a list of projects with location of the bridge, name of latex manufacturer, approximate date of bridge opening to traffic, and owner contact information.
- b. The overlay shall not be placed unless the ambient temperature is 45°F and rising. The overlay shall not be placed if the ambient temperature or deck temperature is above 85°F. When daytime temperatures exceed 85°F, the contractor should consider placing the concrete during very 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 Contracting Authority.
- c. 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. All bonding surfaces shall be free of any laitance or foreign substance prior to the placement of the overlay.
 - Areas of Class A deck repair as defined in Article 2413.01 of the Standard Specifications and designated by the Engineer may be repaired using the VESLMC overlay system, as part of the overlay operation. If these areas will instead be repaired prior to the placement of the VESLMC overlay, they shall be allowed to cure properly and will be subject to the surface preparation of this specification.
 - Areas of Class B deck repair as defined in Article 2413.01 of the Standard Specifications and designated by the Engineer shall be repaired and allowed to cure prior to placement of the VESLMC overlay system. The repair areas shall be subject to the surface preparation of this specification. If use of VESLMC material for Class B deck repair right before overlay is desired, patching needs to be done 15 to 20 minutes before overlay course and make sure to vibrate material in lower patch and again with overlay.
- d. 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.
- e. The VESLMC 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.
- f. A fogging system shall be in place prior to overlay placement. The fogging system shall consist of pressurized equipment that distributes water at a minimum rate of 0.10 gallons per hour per square foot. The fogging system shall apply the fog uniformly over the entire surface of the bridge deck. The fogging system shall produce atomized water that has a droplet with a maximum diameter of 0.003 inches and which keeps the finished deck surface saturated without producing standing water. The fogging system shall be started progressively along the length of the deck during or immediately after floating. The Contractor shall submit a letter certifying that their fogging system is in accordance with this provision.

- g.** During delays in the overlay placement operation of more than 10 minutes or when a plastic film develops on the VESLMC, 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.

5. Curing.

- a.** 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 wet curing period shall be until the minimum desired strength gain of 3000 psi is achieved, with a minimum of 3 hours. Minimum 4000 psi shall be attained in 24 hours. The overlay shall be moist cured from the time placed until open to traffic. No dry curing time is required.
 - b.** 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. Wet curing shall be supplemented with soaker hoses, as required.
- 6.** Representatives of the VESLMC manufacturer knowledgeable in supplying, mixing, transporting, placing, finishing and curing of the VESLMC material must be present during mixing, transporting and placing of the VESLMC. The contractor will arrange for two manufacturer's representatives to be on site for the duration of the VESLMC construction; one representative will remain with the mixing operations and the second representative will remain with the placement operations. Do not start mixing or placing VESLMC until the manufacturer's representatives are on-site. Place VESLMC in accordance with the approved Placement Plan using one continuous pour per each stage of construction. Keep VESLMC from freezing until it has achieved a minimum compressive strength of 3500 psi minimum.
- 7.** The Contractor will arrange for an on-site meeting with the VESLMC manufacturer's representative one day before the start of the actual VESLMC placement. The Contractor's staff and representatives from Iowa DOT District Office, Office of Bridges and Structures, and Office of Construction and Materials, will attend the meeting. The objective of the meeting will be to clearly outline the procedures for mixing, transporting, finishing and curing of the VESLMC.

D. Acceptance Testing.

- 1.** The District Materials Engineer will be on site during the placement of VESLMC. To schedule a representative, contact the District a minimum of 48 hours prior to the anticipated VESLMC placement. Final acceptance will be based upon 28 day strength. Field coring of VESLMC for dispute resolution will not be allowed.
- 2.** The Contractor is responsible for providing an adequate location to place acceptance specimens for initial curing prior to transport to the lab. Compressive strength specimens shall be cured in the same environment as the in-place VESLMC for two hours minimum. Curing boxes will be equipped with supplemental heat as necessary to cure specimens in accordance with ASTM C31. Testing shall be performed by the Contractor and approved by the Engineer. Testing is summarized in Table 2: VESLMC Acceptance Testing. Performance frequencies of each test listed in Table 2, are a minimum value. Tests may be performed at more frequent intervals than described in Table 2, at the discretion of the Engineer.
- 3.** Once the mixers are calibrated, the VESLMC shall be sampled and tested for slump and air content. The Contractor shall prepare and test specimens to demonstrate that the concrete mixture shall obtain a compressive strength of 3000 psi prior to opening the road to traffic and

4500 psi at 28 days. All trial batching and preparation work prior to placing the VESLMC shall be at the Contractor's expense. During the placement of the overlay the Contractor shall take samples for testing.

Description	Test Method	Acceptance Criteria	Frequency
Compressive Strength	AASHTO T 22	≥ 4500 psi (at 28 days)* (3" x 6" cylinders) (150 psi/sec loading rate)	12 tests in 1 st day at intervals specified by engineer, 3 hour, 12 hour, 24 hour, 2 day, 4 day, 8 day, 14 day, & 28 day
Rapid Chloride Ion Penetrability	AASHTO T 277 / ASTM C 1202	≤ 1000 coulombs (4" x 8" cylinders)	Two per job (During field placement)
Slump Flow and Visual Stability	ASTM C1437 / ASTM C 1611	6 inches (Min.) 10 inches (Max.) No bleed water	One per batch

* Don't open the overlay to traffic until it undergoes a minimum 3 hour curing process and the minimum strength gain of 3000 psi is achieved.

E. Surface Profile and Finish.

1. The finished surface of the VESLMC overlay will match the proposed roadway profile to within a tolerance specified in Article 2413.03, E of the Standard Specifications. The extent of the required diamond grinding will be as directed by the Engineer. Grinding and longitudinal grooving can be performed after 24 hours after overlay pouring. Perform longitudinal grooving according to Article 2412.03, D of the Standard Specifications. Transverse grooving or tining in plastic concrete will not be allowed.
2. Traffic or other loading will not be permitted directly on the VESLMC overlay until the VESLMC undergoes the aforementioned 3 hour curing process and achieves a minimum compressive strength of 3000 psi, unless otherwise approved by the Engineer.

150447.04 METHOD OF MEASUREMENT.

The quantity of Deck Overlay (VESLMC) will be measured as the number of square yards of VESLMC placed and accepted. The area will be computed using the dimensions shown on the plans.

150447.05 BASIS OF PAYMENT.

- A. The quantity of VESLMC overlay will be paid at the Contract unit price per square yards. Price and payment will constitute full compensation for surface preparation, supplying, mixing, transporting, forming, placing, finishing, curing, grinding and for furnishing all equipment, tools, labor, and incidentals required to complete the work. Price and payment will also constitute full compensation for sealing the traffic barrier surfaces and replacing the top portion of the joints at both ends of the bridge as shown on the plans and in accordance with Article 2403.03, P, 3 of the Standard Specifications.
- B. Additional quantity of VESLMC material used in the determination of material properties and for acceptance testing as described herein will be furnished at no additional cost to the Contracting Authority. No additional payment will be made for surface preparation or for grinding procedures.
- C. Additional quantity of VESLMC material used to repair areas from hydrodemolition, grinding or

hand removals will be paid for separately as described in the Contract Documents.

- D.** If the VESLMC does not meet the minimal material properties as described herein, the VESLMC will be removed and replaced or remediated to the satisfaction of the Engineer at the Contractor's expense. No additional payment will be made for remedial solutions to insufficient bonding between the VESLMC and underlying bridge elements.