When should High Performance Latex Modified Concrete be used for Bridge Deck Overlays?

History

High Performance Latex Modified Concrete (HPLMC) was developed by the Dow Chemical Company in the 1960’s, specifically as a structural, long term concrete overlay product to quickly and cost effectively rehabilitate bridge decks. It was designed to withstand the harsh environments that bridge decks encounter, by providing for a long term bond to the existing deck concrete, and to give it the flexural strength necessary to remain in service for 25+ years. Some of the very first overlays were done in Michigan and Virginia, and since its inception, tens of thousands of decks have been protected with HPLMC throughout the United States. HPLMC Concrete Overlays are currently being used more than ever.

Bridge Deck Preservation

The use of HPLMC deck overlays has transcended what we now know as “bridge deck preservation.” Bridge decks are currently being preserved beyond 75 years by utilizing second generation HPLMC overlays.

Four Uses

HPLMC overlays can be used in four ways:

First, it can be used on new bridge decks to provide an immediate protective surface for the bridge and to prevent chloride intrusion. Some agencies will use this strategy on very large bridge decks due to the large investment for these major structures. The Arthur J. Ravenel Bridge in Charleston, SC and the Jeremiah Morrow Bridge in Ohio are two recently built very large bridges that utilized HPLMC Overlays as a sacrificial wearing surface.

Second, is the use of HPLMC to preserve and waterproof a deck that only has initial forms of deterioration. These might be bridges that have NBI bridge deck ratings in the 6 or 7 range, meaning it is a sound deck. By performing minimal deck repairs (either through conventional milling and then sounding and patching, or by hydrodemolition), and applying the new HPLMC overlay, the existing deck concrete will be waterproofed and the deck service life will be extended out beyond 25 years.

A third application, the most commonly used, is on decks that are experiencing more significant deterioration and are in need of a more thorough deck surface rehabilitation. These decks are likely in an NBI condition 5 status or in some cases a 4, meaning the deck is still fair or just getting to a poor condition. The entire top surface of these decks are prepared utilizing fast track hydrodemolition to selectively remove all deteriorated and chloride weakened concrete from the deck, and to provide a very bondable surface. The HPLMC overlay is then placed on the hydrodemolished surface. Tens of thousands of decks have been preserved using this application.
A fourth application is to replace a previously installed concrete or asphalt bridge deck overlay that is failing. These are known as second generation HPLMC overlay applications. The existing overlay is milled from the bridge deck and shot-blasting or fast track hydrodemolition is used to prepare the surface. Recently the Brent Spence Bridge in Covington, KY received a second generation HPLMC overlay. The previous HPLMC overlay was removed and replaced after 25 years of service life on one of the heaviest traveled bridges in the US. Many current HPLMC Overlay projects have been installed as second generation overlays.

**What is HPLMC Concrete?**

Latex produced for use in concrete modification is a suspension of tiny Styrene-Butadiene polymer particles in water. They are known as excellent water resistors and coalesce to fuse together and form a waterproof barrier within the concrete. When added to portland cement concrete, a latex modified concrete is produced that serves as a sacrificial wearing surface topping for an existing bridge deck. Depending on the soundness of the deck, these overlays can be expected to provide from 20 to 30 years of protection for the bridge deck. However, when applied to brand new decks, some HPLMC overlays have achieved upwards of 40 years of service life. These wearing surfaces act as sacrificial systems that prevent the intrusion of chlorides and moisture from reaching the deck. After its effective life is completed the HPLMC surface can be milled off and another HPLMC overlay applied.

**Characteristics of LMC**

LMC overlays are generally thin lift applications about 1 1/2” to 2” in total thickness. They can also be inlaid into the existing deck to the same grade and profile. Bond of the overlay to the base concrete is a vital component of the overlay process, and with proper surface preparation LMC will adhere tenaciously to the deck and allow it to act monolithically. Other characteristics which make HPLMC attractive as an overlay include its flexibility and reduced modulus of elasticity which allows it to distribute service loads and minimize stresses at the bond interface. This is also important to reduce crack propagation. HPLMC overlays are very dense to prevent the intrusion of calcium chloride to the deck. As HPLMC uses a lower water cement ratio than normal portland cement concretes, it has less free water to dissipate. This means shrinkage is reduced. Only an experienced crew should be used to install HPLMC overlays.

**Accelerated Construction using VESLMC**

In cases where rapid restoration is desired in order to quickly repair and overlay a bridge deck, such as over a weekend, or in extreme cases overnight, an accelerated mix using Rapid Set Cement can be used in conjunction with latex to form a Very Early Strength Latex Modified Concrete mix design. The bridge deck is ready for traffic in just 3 hours after placement of the VESLMC overlay.

**Conclusion**

HPLMC overlays can be used almost anytime throughout a bridge decks life. This overlay is good for new bridge decks, as preventive type treatments for preserving an in service deck, and also for extensive repair and reconstruction type projects on deteriorating decks. It is not a cure for bridge decks that have reached the end of their effective life and have extensive full-depth repair needs. A proven tactic to preserve bridge decks is to utilize a systematic approach that includes HPLMC overlay applications on a 25-year interval.