



# **BRIDGE DECK CONCRETE OVERLAYS**

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Challenges and Inspection

Doug Beer, PE

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# Overview

- 1 Types of Overlays
- 2 Selecting Overlay Type
- 3 Repair Prior to Overlay
- 4 Surface Preparation
- 5 Material Consistency
- 6 Curing
- 7 Challenges & Inspection

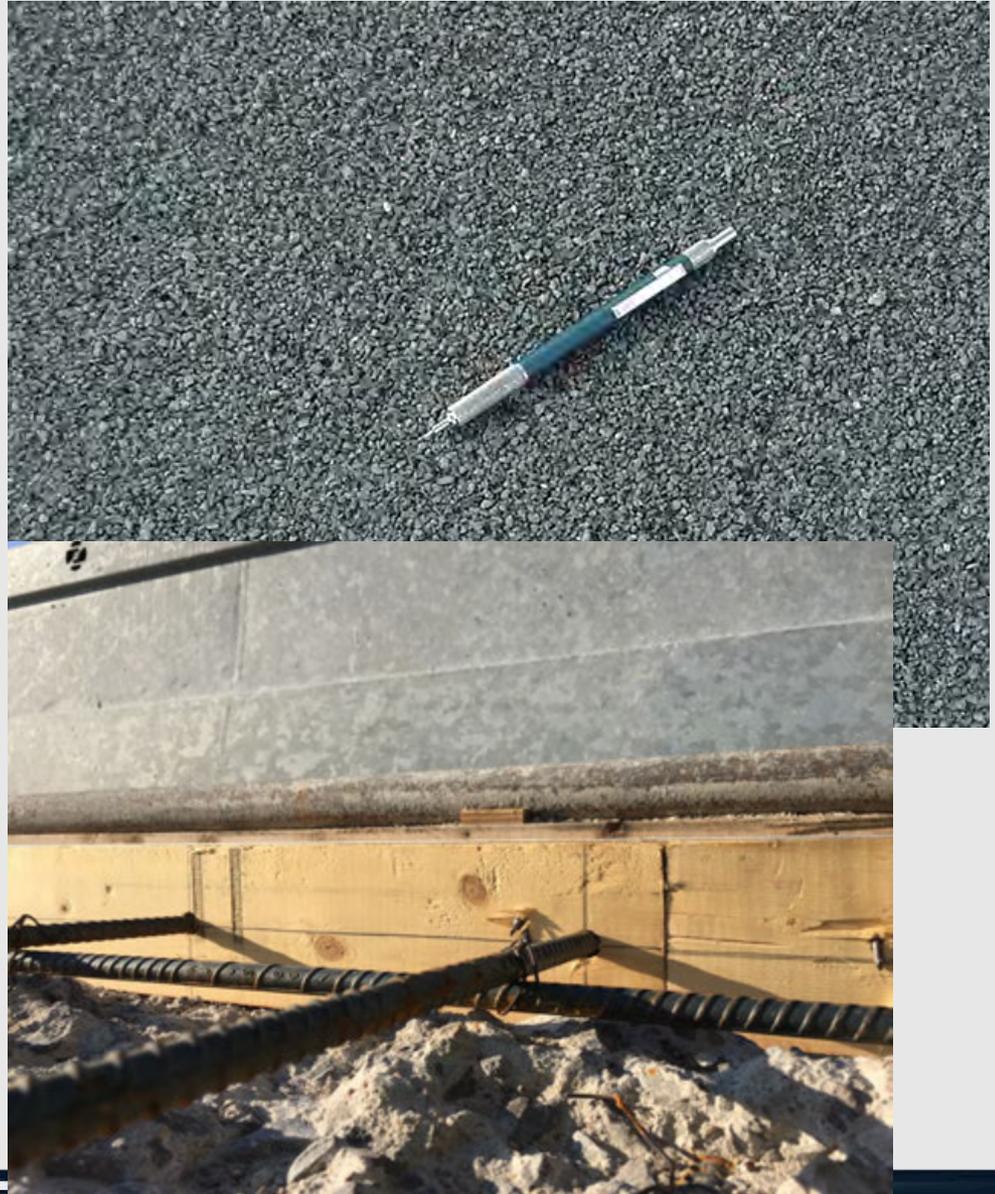
# Types of Overlays

- Dense Concrete Overlay
- Reinforced Concrete Overlay
- Latex-Modified Concrete Overlay
- Multi-Layer Polymer Overlay



# Overlay Selection

- Define Need
  1. Restoring Skid Values
  2. Sealing Cracks
  3. Matching New Profile
  4. Adding Structural Value
  5. Chloride/Corrosion Protection



# Overlay Selection

- Multi-Layer Epoxy Overlays – Improving Skid Values and Crack Sealing
- Concrete Overlays – Matching New Profiles, Structural Capacity, & Chloride/Corrosion Protection



# Concrete Overlays

- Dense Concrete Overlays – HPC Concrete with a Course Aggregate factor of at least 0.55, Class of Concrete C0
- Reinforced Concrete Overlays – HPC Concrete with Fibers or Reinforcing Steel. Course Aggregate factor of at least 0.55, Class of Concrete C0
- Latex Modified Concrete Overlays – 24.5 gals/cy of Latex and 18.9 gals/cy of Water (do not usually need that much water), 658 lb/cy of cement. Class of Concrete LMC

# Item 439 – Bridge Deck Overlays

- Materials
- Equipment
- Construction
- Measurement
- Payment



# Item 439 – Bridge Deck Overlays

## MATERIALS

### 2. MATERIALS

Provide materials conforming to the pertinent requirements of the following Items except as noted below.

- Item 421, “Hydraulic Cement Concrete,” and
- Item 440, “Reinforcement for Concrete.”

2.1. **Latex for LMC.** Provide latex admixture meeting the requirements of [DMS-4640](#), “Chemical Admixtures for Concrete.”

Store latex at temperatures between 40°F and 85°F. Do not allow latex to freeze.

2.2. **Grout for CO or LMC.** Provide grout for bonding new concrete to existing concrete consisting of equal parts by weight of hydraulic cement and sand when shown on the plans. Mix with sufficient water to form a stiff slurry, which can be applied with a stiff brush or broom to the existing concrete in a thin, even coating that will not run or puddle in low spots.

# Item 439 – Bridge Deck Overlays

## ▪ EQUIPMENT

### 3. EQUIPMENT

#### 3.1. Surface Preparation Equipment.

3.1.1. **Concrete Removal and Surface Preparation.** Provide equipment meeting the requirements of Item 483, “Concrete Bridge Deck Surfacing.”

3.1.2. **Abrasive Blasting.** Provide equipment capable of removing oil, dirt, slurry, curing compound, laitance, etc., from the surface of the concrete.

3.1.3. **Sawing.** Provide equipment capable of sawing concrete to the specified depth when required.

3.1.4. **Power-Driven Chipping Tools.** Provide tools not heavier than a nominal 30 lb. class for bulk removal of concrete.

3.1.5. **Chipping Hammers.** Provide chipping hammers not heavier than a nominal 15 lb. class to remove concrete beneath any reinforcing bars.

3.1.6. **Cleaning.** Provide magnetic equipment followed by vacuum equipment to remove spent steel shot. Provide vacuum equipment for final cleaning of prepared surfaces unless otherwise approved.

# Item 439 – Bridge Deck Overlays

## ■ EQUIPMENT

3.2. Proportioning and Mixing Equipment.

3.2.1. **Grout Mixer.** Provide a volumetric continuous or mortar mixer.

3.2.2. **Concrete Overlay.** Follow applicable provisions of Item 421, “Hydraulic Cement Concrete.”

3.2.3. **Latex-Modified Concrete Overlay.** Follow the applicable provisions of Item 421, “Hydraulic Cement Concrete.” Proportion and mix the latex-modified concrete at the project site using a suitable approved mixer capable of thoroughly mixing the ingredients to a uniform consistency.



# Item 439 – Bridge Deck Overlays

## ■ EQUIPMENT

### 3.3. Placing and Finishing Equipment.

3.3.1. **Hand Tools.** Provide sufficient hand tools for placing, consolidating, striking off, and finishing stiff plastic concrete.

3.3.2. **Finishing Equipment for Concrete Overlay.** Provide an approved surface vibrator moving ahead of the finishing machine or an approved vibrating screed for overlay consolidation. Provide work bridges or other suitable facilities to perform all finishing operations.

3.3.3. **Finishing Equipment for Latex-Modified Concrete Overlay.** Provide a mechanical strike-off to ensure a uniform thickness of concrete in front of the screed. Design the bottom face of the screed to minimize tearing of the surface of the plastic concrete.

Provide a finishing machine capable of forward and reverse motion under positive control. Make appropriate provisions for raising the screeds to clear the screeded surface for traveling in reverse. Equip the finishing machine to travel on and screed off of any adjacent completed lane without damaging it. Use approved manual screeds and vibrators to consolidate and finish small or irregular areas inaccessible to the finishing machine. Provide work bridges or other suitable facilities to perform finishing operations and density checks.

# Item 439 – Bridge Deck Overlays

## ■ CONSTRUCTION

- 4.2. **Classification and Mix Design.** Provide a mix design in accordance with Item 421, “Hydraulic Cement Concrete.” Use a water reducing chemical admixture as necessary to achieve the desired consistency without exceeding the specified water to cementitious material ratio. Provide a mix design with an entrained air content of the fresh concrete of 6% with a tolerance of  $\pm 1\%$  when tested in accordance with [Tex-414-A](#) or [Tex-416-A](#) together with the following requirements:
- 4.2.1. **Concrete Overlay.** Provide Class CO concrete with a coarse aggregate factor of at least 0.55.
- 4.2.2. **Latex-Modified Concrete.** Provide Class LMC concrete with a cement content of at least 658 lb. per cubic yard, a latex admixture content of at least 24.5 gal. per cubic yard, and a water content of no more than 18.9 gal. per cubic yard. Provide a mix design using a coarse aggregate volume of 30% to 45% by weight of the total aggregate and a weight ratio of cement-to-sand to coarse aggregate of 1.0:2.8:1.7 based on aggregate in a saturated surface-dry condition. Use a commercially available antifoaming agent with the polymer modifier as necessary to control the air content in the mix.

# Item 439 – Bridge Deck Overlays

## Item 421

- 3.1.2. **Volumetric Mixers.** Provide volumetric mixers with rating plates defining the capacity and the performance of the mixer in accordance with the Volumetric Mixer Manufacturers Bureau or equivalent. Provide volumetric mixers that comply with ASTM C685. Provide test data showing mixers meet the uniformity test requirements of [Tex-472-A](#).

Unless allowed on the plans or by the Engineer, volumetric truck (auger) mixers may not supply classes of concrete identified as structural concrete in Table 8.

CO <sup>6</sup>	4,600	0.40	6	I, II, III, IP, IS,	1-8	Bridge deck concrete overlay
LMC <sup>6</sup>	4,000	0.40	6-8			Latex-modified concrete overlay

6. Structural concrete classes.

## Item 439

- 3.2.3. **Latex-Modified Concrete Overlay.** Follow the applicable provisions of Item 421, "Hydraulic Cement Concrete." Proportion and mix the latex-modified concrete at the project site using a suitable approved mixer capable of thoroughly mixing the ingredients to a uniform consistency.

# Item 439 – Bridge Deck Overlays

## ■ Material Controls

- As with all structural concrete, trial batches and mix consistency is key to a successful overlay.
- Several Trial batches may be needed to achieve the optimum mix design, this can get costly with the price of Latex. Work with suppliers and contractors for compensation or make subsidiary through General Notes.
- Specification recommends 1.0 : 2.8 : 1.7 weight ratio of cement-sand-coarse aggregate, with a coarse aggregate volume of 30% - 45% by weight of total aggregate. Work with contractor/supplier to minimize paste volume by decreasing sand content and increasing coarse aggregate. Good mix design practices should used when creating LMC mix design, less paste.
- Check with local Redi-Mix suppliers and try to get them to bid LMC Overlay projects.
- Steel Fibers can be added, approximately 40lbs/cy

# Item 439 – Bridge Deck Overlays

➤ Fresh Concrete with Steel Fibers



## Item 439 – Bridge Deck Overlays

- Volumetric Mixers have had success with LMC Overlays, but consistency is problematic. Performing good trial batches with Volumetric Mixers is difficult. Require the supplier with calibrated equipment and operator to perform the trial batches ahead of placement operations. If material properties change (moisture content) between time of trial batch and placement, perform additional concrete testing and equipment calibration before overlay operations commence.
- The specification does not limit LMC to volumetric mixers.
- Redi-Mix suppliers are hesitant with LMC, but it has been done successfully several times. Material consistency is greatly improved and performance enhanced. It should be encouraged to utilize these suppliers, but, additional chipping/cleaning of mixer drums should be anticipated and bid.

# Item 439 – Bridge Deck Overlays

## ▪ CONSTRUCTION – REPAIR EXISTING CONCRETE BRIDGE DECK

Remove and dispose of deteriorated or delaminated areas of concrete as shown on the plans or as determined by the use of a sounding hammer, chain drag, or other acceptable device, and by visual inspection after scarifying as approved.

Remove and repair deteriorated concrete below the indicated depth of scarification in accordance with Item 429, "Concrete Structure Repair." Use only hydraulic-cement concrete for these repairs. Ensure the repaired surface is flush with the surrounding scarified surfaces. Allow the repair concrete to cure before placing the overlay concrete unless approved otherwise. When approved, placing repair concrete in partial depth deck repairs may be done concurrently when placing the overlay concrete.

### Preferred Repair Material

- CL S Concrete if Cure Time Permits
- HES for Accelerated Construction
- When Approved, Repair Concurrently with Overlay

# Item 439 – Bridge Deck Overlays

- Bridge Deck Repair Prior to Overlay



# Item 439 – Bridge Deck Overlays

## ■ CONSTRUCTION – SURFACE PREPARATION

- 4.3. **Surface Preparation.** Do not scarify concrete surfaces with a grooved or tined finish unless shown on the plans. Prepare these surfaces by abrasive blasting or water-injected abrasive blasting as required to remove dirt, oil, curing compound, laitance, surface mortar, and other material that would inhibit bonding of the overlay, but leave the striations intact.

Scarify the surfaces of slabs to be rehabilitated to the depths shown on the plans using the method specified in accordance with Item 483, "Concrete Bridge Deck Surfacing."

### Item 483

- Milling
- Hydro-Demolition
- Shot Blasting



# Item 439 – Bridge Deck Overlays

## ■ CONSTRUCTION – SURFACE PREPARATION

- Milling
- Hydro-Demolition
- Shot Blasting



# Item 439 – Bridge Deck Overlays

## ■ CONSTRUCTION – SURFACE PREPARATION

- Milling
- Hydro-Demolition
- **Shot Blasting**



# Item 439 – Bridge Deck Overlays

## ■ Surface Preparation

Remove the concrete surrounding the reinforcing bars to a minimum depth of 1/2 in. below the bar to permit the new concrete to bond to the entire periphery of the exposed bar if reinforcing steel is exposed during bridge deck surfacing.

Clean all exposed reinforcing steel, scarified surfaces, and newly exposed concrete surfaces including construction joints against curbs or parapet walls by wet or dry abrasive blasting. Blast corroded reinforcing steel to gray metal. Remove and place all blast debris in an approved disposal site. Repair or replace damaged reinforcing steel as required.

- Surface Preparation Should Occur as Close as Possible Before Overlay Placement
- For Multiple Span Bridge, Specify Multiple Mobilizations of Surface Preparation
- Specify Additional Pressure Washing Prior to Overlay
- Sand-Blasting will be needed in areas that are inaccessible to Deck Surfacing Equipment, expansion joints, etc.



# Item 439 – Bridge Deck Overlays



# Item 439 – Bridge Deck Overlays

- Placing and Finishing Concrete
  - Perform Dry-Run Inspection and Verify Overlay Thickness and Cleanliness
  - Ensure Expansion Joints are formed so that overlay will not be in contact with the adjacent span.
  - Moisten Surface to SSD
  - Apply bonding grout as specified, do not allow bonding grout to dry prior to overlay placement.
  - Vibrate overlay to ensure adequate consolidation in corners and angles and around exposed reinforcing steel.
  - Use mechanical screeding device to strike off overlay and finish the surface to final grade
  - Hand-finish edges and joints to ensure tight and uniform finish.

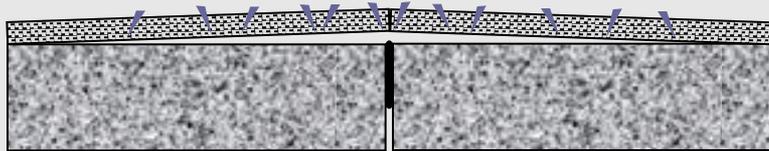
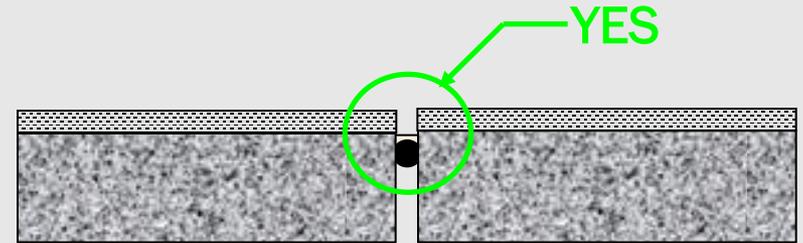
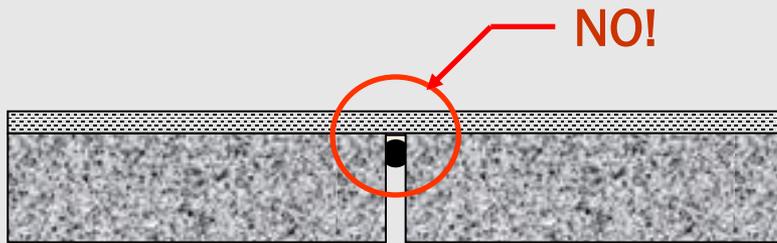
# Item 439 – Bridge Deck Overlays



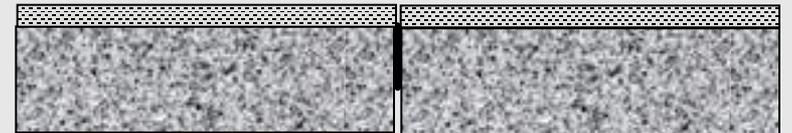
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## Armor Joint Isolation

Accomplished by: Placing backer rod to fill joints, then scoring before polymer gels or saw cutting after its fully cured

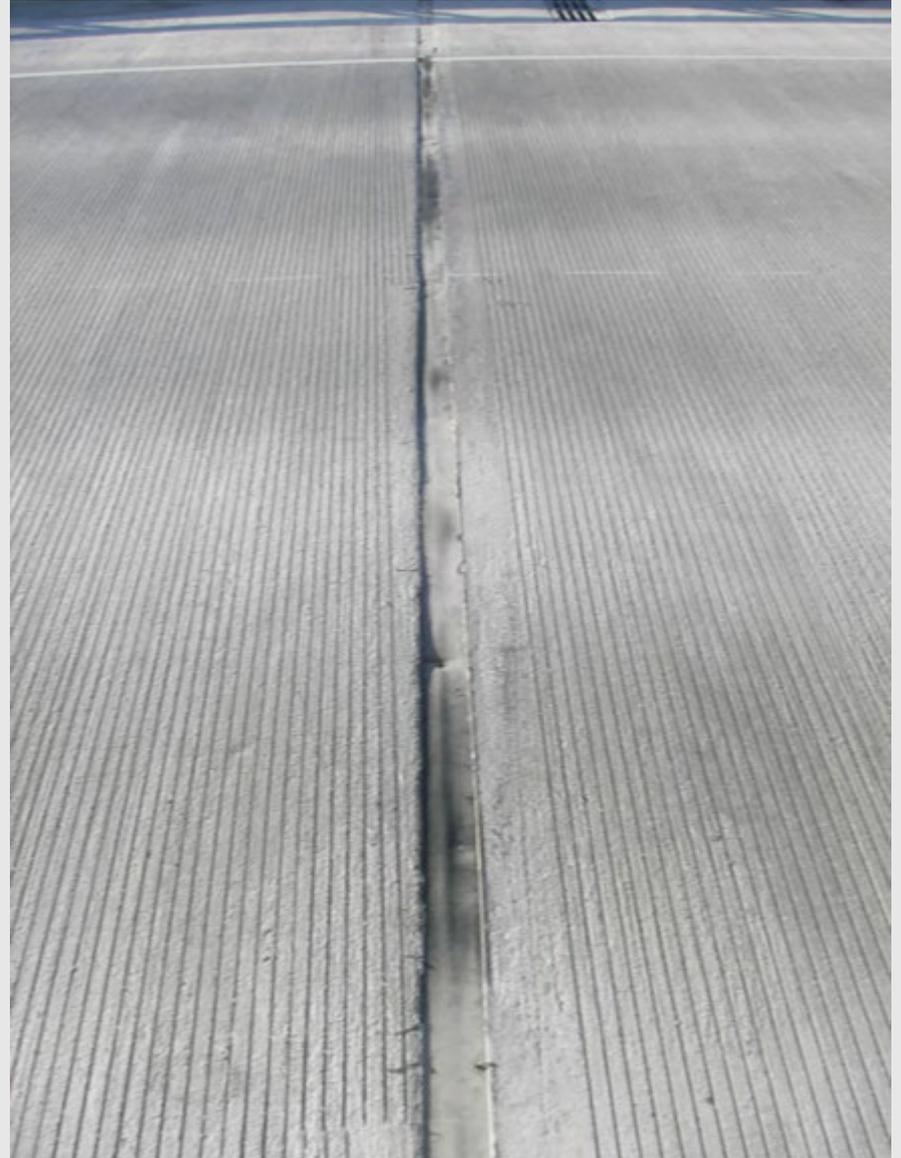


Overlay cracks and pulls away from the deck.



Overlay moves along with the deck.

# Item 439 – Bridge Deck Overlays



# Item 439 – Bridge Deck Overlays

## Application of Bonding Grout



# Item 439 – Bridge Deck Overlays

LMC with Bonding Grout and Expansion Joint Covered



# Item 439 – Bridge Deck Overlays

Mechanical Screed with Pan Float and Burlap Drag



# Item 439 – Bridge Deck Overlays

Hand Finish Edges and Forming at Armor Joint



# Item 439 – Bridge Deck Overlays

## Manual Screeding and Vibrators for Small Areas



## Item 439 – Bridge Deck Overlays

- Curing

- This is a critical step in bonded bridge deck overlay success.
- Due to the thin overlay and large surface area, plastic/drying shrinkage is problematic. Limited bleed water and rapid evaporation induce cracking, curling, and warping. This causes the edges of the overlay to de-bond and ultimately progress to interior and delaminate the overlay.
- Traffic vibrations can also prohibit good overlay bonding, if possible, detour traffic during the curing phase.
- HPC Concrete Overlays should be treated similar to typical bridge deck curing methods, however, the time of application of evaporation retardant, interim curing, and final curing should be monitored closely and applied as soon as possible.
- LMC Overlays should have curing placed immediately, missing this window will cause plastic shrinkage cracking.

# Item 439 – Bridge Deck Overlays



# Item 439 – Bridge Deck Overlays



# Item 439 – Bridge Deck Overlays

- Curing

- Ensure an adequate quantity of wet burlap is available prior to placing concrete.
- Ensure adequate man-power is dedicated to the curing operation.
- Do not allow burlap to dry, continue to apply water until the plastic sheeting is placed.
- Contractor will need to monitor curing operation and add water as needed, at minimum, first 24 hours is critical to the overlay.



# Item 439 – Bridge Deck Overlays

## The Cure Blanket Toss



# Item 439 – Bridge Deck Overlays

## Burlap Blanket Station



# Item 439 – Bridge Deck Overlays

- LMC Issues

- The most widespread problem with LMC overlays is cracking. LMC has good bonding characteristics with proper surface preparation and cleaning.
- Application of finish water and curing water is counterintuitive of typical concrete bridge deck practices.
- Latex is approximately 50% styrene-butadiene and 50% water, the W/C ratio can be very low. This causes the system to have minimal water for hydration and therefore rapid loss of bleed water occurs.
- As soon as the LMC forms a “skin”, wet burlap should be applied. And water applied generously to the blankets, apply plastic sheeting ASAP and continue with application of water.
- Surface finish of LMC Overlays will be compromised by the quick application of burlap, but should not affect ride if original grading of the screed and forms are true.

# Item 439 – Bridge Deck Overlays

- LMC Issues

- Super-elevated cross-slopes and phased construction, will cause the LMC to creep downhill and could make construction joints rough, due to slump.
- Cross-slope should be considered when selecting LMC overlays.
- Phase/construction joints should not occur at wheel paths and may require grinding.
- The edges of the overlay where the screed rail was set will need to be filled in after overlay placement with similar concrete or TY D Standard repair material.



# Item 439 – Bridge Deck Overlays

- Surface Preparation Issues

- Hydro-demolition provides a very aggressive surface texture and will enhance mechanical bonding, less slipping and delamination. But, the concrete fines will be left in the valleys and need to pressure washed prior to placement of reinforcing or overlay.
- Shot-blasting provides a clean and bondable surface, but should be done within 48 hours(?) to ensure no contamination occurs. Recommend multiple mobilizations of the shot-blasting operation if several spans will be poured at different dates.
- Air Compressor Cleaning is desirable, leaf blowers will work but not as effective.
- Specify through General Notes additional pressure washing prior to overlay, 4000-7000 psi recommended. Specification states water blasting, which can be open to contractor interpretation in the field.

# Item 439 – Bridge Deck Overlays



# Item 439 – Bridge Deck Overlays



# Item 439 – Bridge Deck Overlays



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# Item 439 – Bridge Deck Overlays



# Item 439 – Bridge Deck Overlays



# QUESTIONS?

Doug Beer, P.E.

Bridge Division Construction &  
Maintenance

[doug.beer@txdot.gov](mailto:doug.beer@txdot.gov)

512-416-2824

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