25 Year Bridge Deck Repair & Preservation using Total Deck Surface Fast Track Hydrodemolition and Latex Modified Concrete Overlays

2017 Western Bridge Preservation Partnership
Denver, CO

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Bridge Deck Preservation

- It is very cost effective to attain a minimum of 75 years of service life from a bridge deck.

- By placing Latex **Modified Concrete Overlays** on **Hydrodemolition** prepared bridge deck surfaces before decks become structurally deficient, 75 years of service life or more can be achieved.

- The use of **Fast Track Hydrodemolition** and **Latex Modified Concrete Overlays** will provide an owner with an **economical, long lasting and very fast bridge deck preservation method.** Used for 50 years.
Bridge Deck Preservation Strategies

- **75 Year Bridge Decks**
  - Year 1   – Construct New Bridge Deck
  - Year 25 – Place LMC O/L #1 – Hydrodemolition
  - Year 50 – Place LMC O/L #2 – Hydrodemolition
  - Year 75 – Replace Bridge Deck (Third O/L ? = 100 years)

*Systematic Approach – utilize bridge deck inspections.*
Hydrodemolition & LMC Use in the United States

North Carolina 2012 - 2015 – 68 Projects = 600,000 sy

Pennsylvania = 850,000 sy in last 6 years

Ohio – over 1,000,000 sy of concrete overlays since 2000

OK, IA, VA, WV, IL, TX, MO, MT, MA, MD, LA, IN, MI, KY, AL, GA, AR, OK + others
Hydrodemolition & LMC Specification

Special Provisions

Latex Concrete Bridge Deck Overlay

Fast Track Total Surface Selective Hydrodemolition

- SY Pay Items
- CY Pay Item for Variable Depth LMC – material costs only
- Selective Removal Hydrodemolition Robot Settings
Fast Track / Total Surface Hydrodemolition
Bridge Deck Surface Preparation
Hydrodemolition Definition

- Hydrodemolition is a mechanical process by which deteriorated concrete is selectively removed utilizing a high pressure water jet.

- By rapid erosion with the high pressure water, the cement matrix and fine aggregates between the course aggregate is essentially washed away.

- By properly calibrating the hydrodemolition robot movements, concrete of uniform strength can be removed to a specified depth + unsound deteriorated concrete with one pass of the robot = Selective Removal.
Hydrodemolition Applications

- Surface preparation of the total area of bridge decks prior to placement of overlays.

- Surface preparation for patches in bridge decks.

- Full Depth Removals

- Selective portions of structures removed – bridges, shipping piers, factory’s, parking garages, nuclear power plants, tunnels.
Fast Track Hydrodemolition Surface

- Fast way to prepare a bridge deck surface for a concrete overlay.
- Selectively removes deteriorated concrete at variable depths.
- Highly rough and bondable surface.
- Reduces Chloride Ion concentrations in the deck.
- With proper milling, only sound concrete remains.
- Has 300% to 400% more bondable area than surface milling alone.
- Stone is not cut – aggregates are protruding.
- Exposes and cleans reinforcing steel. Will not damage or dislodge reinforcing steel.
Hydrodemolition Equipment

• Consists of Pump & Power Unit, Hydrodemolition Robot and Vacuum Truck.
• Can be readily mobilized to any project.
• Set up time is quick and relatively easy.
Hydrodemolition Pump Unit

- Receives water intake from either tankers, hydrant or directly from stream or lake.
- Filters and pressurizes water.
- Supplies water at 15,000 psi and 55 ga/min to the Hydrodemolition Robot.
- Selective Removal Settings
Hydrodemolition Robot

- Computerized and Self-Propelled.
- Water from the power unit exits through a $\frac{1}{4}$” jet nozzle.
- Controls allow operator to control the removal depth of the concrete by adjusting the step of the machine and the glide of the water jet.
- Oscillating Direct Impact Jet vs Rotating Spin Jet
Hydrodemolition Vacall Unit

- Cleans and washes bridge deck surface.
- Removes all hydrodemolition debris and slurry.
The Fast Track Hydrodemolition/LMC Modified Concrete Bridge Overlay Method

- Fastest and most cost effective way to overlay a bridge deck.
- A minimum of 25 years of service life will be attained by the overlay if surface is properly prepared and overlay is properly placed.
- Consists of 4 steps
The Fast Track Hydrodemolition/Modified Concrete Bridge Overlay Method

- Step 1 – Mechanical Milling of the Existing Bridge Deck Surface to a Specified Depth or to the Top Matt of Reinforcing Steel.

- Mill for depth – Cost Effective
- Mill to top mat of reinforcing steel.
The Fast Track Hydrodemolition/Modified Concrete Bridge Overlay Method

- Step 2 – Perform Total Surface Hydrodemolition.
- Hydro to get the bad concrete out below the milling line and to provide a highly bondable surface.
- Do not hydro for depth – not cost effective.
- Measure to the Mortar line
- Do not jackhammer under partially exposed reinforcing steel
The Fast Track
Hydrodemolition/Modified Concrete Bridge Overlay Method

- Step 3 – Final Cleaning of the Bridge Deck Surface and Minor Hand Chipping in Areas Inaccessible to The Hydrodemolition Equipment.
- Clean closely behind the hydro robot.
- Do not leave loose debris or slurry on the bridge deck surface.
Fast Track Hydrodemolition Advantages

- **Speed** – A fast, productive and economical way to prepare a bridge deck for a Modified Concrete Overlay.
- **Quality** - Selectively removes delaminated concrete and avoids the unnecessary removal of sound concrete.
- **Removes** chloride contaminated concrete.
- **Will not damage** existing reinforcing steel. Actually cleans the steel.
- **Surface** has 300 % to 400 % more bondable area than a mechanical milled surface.
- **Cost Savings** - Long term service life and maintenance cost savings. Immediate traffic control and road user cost savings.
Jack hammer the method of yesterday

- Damage to rebars.
- Vibrations in the rebars cause long distance damage to the bond in the structure.
- Causes new micro cracks.
- No selective removal.
- Labour intensive.
- Hand and arm vibrations.
- Slow and noisy.
Micro cracks and no bond is shown on a thin section after use of a jackhammer.
Thin section sample after using Hydrodemolition showing no micro cracks
Step 4 – Placement of Modified Concrete Overlay.
Place during optimum weather conditions.
Surface must be extremely clean and in a damp condition.
Latex Modified Concrete Characteristics

- LMC was specifically designed (1960’s) for use as a thin bonded concrete bridge deck material. It’s quality has withstood the test of time.

- A LMC Overlay is a structural bridge deck repair that will extend the service life of a bridge deck for over 25 years when placed on a hydrodemolition prepared concrete surface.

- LMC is very adhesive and develops great bond strengths to the existing deck.
- LMC shields the underlying deck because it is very impervious.
- LMC has greater flexural strength than conventional concrete.
- LMC is very wear resistant and improves the skid resistance on bridge decks.
- LMC has a very low water/cement ratio. This characteristic prevents shrinkage cracking from occurring in the overlay.
Latex Concrete Mix Design

- Fine Aggregate (Sand) - 1575 - 1855 lbs/cy
- Course Aggregate (# 8’s) - 1106 - 1386 lbs/cy
- Cement (7 bags) - 658 lbs/cy
  (Can use Rapid Set Cement for weekend or overnight pours)
- Latex Emulsion - 24.5 gal/cy
- Water - 17.5 gal/cy - .45 w/c ratio
- Maximum Air - 7%
- Slump - 4 to 6 in

** Cement = Type 1, Type 3 or Rapid Set
Latex Emulsion

- Suspension of tiny (.2 micron diam.) styrene-butadiene polymer particles in water, typically about 50% polymer solids.

- Styrene-butadiene polymers are known for their hydrophobicity or excellent water resistance.

- Polymer particles coalesce or fuse together when in intimate contact to form a highly waterproof polymer film.

- Essentially waterproofs concrete.
**Very Early Strength Latex Modified Concrete**

- Add very early strength hydraulic/portland cement to the LMC mix.
- Achieves compressive strengths of over 2,500 psi in 3 hours – traffic ready.
- Provides the same benefits as LMC overlays.
- VESLMC has been used on projects in the US since 1991.
- VESLMC is very impervious to chemicals that deteriorate standard concrete.
- VESLMC overlays result in better bonding and less cracking.
- A VESLMC Overlay placed on a Hydrodemolition prepared surface is the fastest construction method to preserve a bridge deck. Typically used on weekend and overnight projects.
- 20 years of additional service life is instantly added to your bridge deck.
TYPICAL WEEKEND SCHEDULE:

**Friday**
- 9:00 pm to 10:00 pm - Close roadway.
- 10:00 pm to 12:00 am - Remove Ex. O/L.
- 12:00 am - Hydrodemolition.

**Saturday**
- 12:00 am to 12:00 pm - Hydrodemolition.
- 12:00 pm to 12:00 am - VESLMC O/L.

**Sunday**
- 12:00 am to 4:00 am - Cure VESLMC O/L.
- 4:00 am to 12:00 pm - Cleanup work area.
- 12:00 pm to 2:00 pm - Open roadway.
Questions / Contact Info

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- We offer technical presentations, field demonstrations, simple plans, specification development and Professional Engineering Services.