Bridge Deck Repair & Preservation using Hydrodemolition & Latex Modified Concrete Overlays

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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 becomes 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 is a mechanical process by which deteriorated concrete is selectively removed utilizing a high-pressure water jet. It replaces jackhammers – cost effective, efficient and precise. Rapid erosion occurs with the high-pressure water jet. The cement matrix and fine aggregates between the coarse 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 Equipment

• Consists of a Pump & Power Unit, a Hydrodemolition Robot and a 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 water tankers, a fire hydrant or directly from a stream or a lake
- Filters and pressurizes the water
- Supplies water at 12K to 20K psi minimum and 55 gal/min minimum to the Hydrodemolition Robot
- Selective settings
Hydrodemolition Pump Unit
Hydrodemolition Robot

- Computerized and Self-Propelled
- Water from the power unit exists 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 + pressures and flow rates.
- Safety
Hydrodemolition Robot
Hydrodemolition Vacall Unit

• Cleans and washes bridge deck surface.
• Removes all hydrodemolition debris and slurry.
Vacall Unit
Vacuum Tube Unit
Hydrodemolition Applications

Fast-Track Hydrodemolition - Surface preparation of total bridge deck area prior to placement of overlays.

- Cost Range - $25 to $75/sy
- Production – 750 sy to 1200 sy / shift (based on calibration)
- Always milling first – mill for depth
- Highly Bondable Surface + Selective Removal
- Latex Modified Concrete Overlays
- Toledo Skyway Bridge - Ohio
- Baltimore Harbor Tunnel - Maryland
Toledo Skyway Bridge
Baltimore Harbor Tunnel
Low Point of Tunnel = 5+37.5

Baltimore Harbor
Fast-Track Hydrodemolition Surface

- Fastest 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.
Fast Track Hydrodemolition Surface

Diagram showing the comparison between the existing surface, milled surface, and hydro surface.
Fast Track Hydrodemolition
Midwest

- **Indiana** – 2/10 letting = 11 projects, 1/13 letting = 7 projects
  - 2019/2020 = 166 projects, 406,000 sy of deck area
- **Illinois** – 1/15 letting = 17 projects, 47,500 sy
  - 2019/2020 = 108 projects, 220,500 sy of deck area
- **Ohio** – 2019/2020 = 76 projects, 290,000 sy of deck area
- **Kentucky** – 2019/2020 = 35 projects LMC overlay
- **Missouri** – 2019/2020 = 18 projects, 62,000 sy of deck area
- **Oklahoma** – 2020 = 14,500 sy LMC – Pensacola Dam
- **Michigan** – 2019/2020 = 21 projects, 41,000 sy of deck area
- **Iowa** – 6 projects, 8028 sy
Hydrodemolition Applications

**Deep-Cut Hydrodemolition** - Rebar exposure of bridge deck + Selective Removal

- Cost Range - $150 to $250/sy
- Production – 150 sy to 400 sy / shift
- Always milling first to top matt of resteel
- Newport Bridge – Road Island
Newport Bridge
Hydrodemolition Applications (less common)

- Bridge Deck Patching Surface Preparation
- Full Depth Concrete Removal
- Expansion Joint Removal & I-Beam Exposure
- Vertical Applications
  - Bridge Piers, Parapet Walls, Tunnel Walls, Dam Spillways
- Water Treatment Plant Clarifiers, Parking Garages, Factory Floors, Nuclear Power Plants
Latex Concrete Mix Design

- Fine Aggregate (Sand) - 1505 - 1715 lbs/cy
- Course Aggregate (size 9-M) - 1155 - 1365 lbs/cy
- Cement (7 bags) - 658 lbs/cy – min.
- Water - 154 lb/cy - .40 w/c ratio max
- Maximum Air - 7 %
- Slump - 4 to 6 in – after 5 min.

* 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.
LMC Equipment

- Volumetric mixer used to produce LMC – 601.02
- Calibration of mixer
- Bidwell type finish machine used to achieve proper grade and profile – 609.02.09 (furnish a Department approved machine)
Mobile Mixer
Research

Hydrodemolition for Bridge Repair
reprint Nordisk Betong no. 2-3:1988

Techniques for Concrete removal and Bar Cleaning on Bridge Rehabilitation Projects
National Research Council:SHRP-S-36:1992

Successful Approaches for the Use of Hydrodemolition for Partial Depth Removal of Bridge Decks

Sampling and Testing LMC for Permeability to Chloride Ion
Michael M. Sprinkle – Virginia Transportation Research Council:2008

University of Texas – Austin Field Trials
Anthony F. Bentivegna, Kevin J. Folliard, Jason H. Ideker: 2010
Initial Setup

Hydro-Tech Transportation Rig

Slabs Prior to Hydro-demolition
Initial Setup

Hydro-demolition Robot on Truck Bed

Initial Setup
Calibration

Initial Depth Calibration

Hydro-demolition Robot
Formwork
Rapid-Set Pour
Curing
Questions / Contact Info

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We offer technical presentations, field demonstrations, single plans, specification development, and professional engineering services