DETERIORATED SLUICEWAY AT A DELAYED COKING UNIT AND AN INNOVATIVE T/A REPAIR SOLUTION
Background

- Delayed Coker Unit is reported to be 1940’s vintage
- Sluiceway directs hot process fluids assisted by high-pressure water jets
- Hydrocarbon based products exceeding boiling point of water
Background

- Type II PC concrete
- Structural Steel Hot Dip Galvanized
- Exposed concrete surfaces intended to be protected with epoxy coating
- Railroad track gage width = 56-3/8 in.
Condition Survey

◆ Field Investigation
  • Visual Inspection
  • Acoustic Impact Testing
  • Rebound Hammer Testing
  • Sample Extraction

◆ Laboratory Tests
  • pH Testing and Carbonation Depth Determination
  • Chloride Ion (Cl⁻) Content
  • Compressive Strength Testing
Field Investigation
Visual Inspection

- Documentation of observed deterioration in the form of cracks, delaminations, spalls, etc.
- Physical measurements for comparison of as-design details
Non-Destructive and Semi-Destructive Testing (NDT & SDT) techniques provide insight to assemble an accurate assessment.
Partial Plan View of Sluiceway
Laboratory Tests
Chloride-Induced Corrosion

- Oxygen
- Chlorides
- Moisture

[Diagram showing the process of chloride-induced corrosion]
Compressive Strength Testing

- Drilled core compression test report
- Certified third party laboratory
- 6,410 to 8,720 psi
- Based on ACI guidelines, average compressive strength exceeds 9,000 psi
Findings and Recommendations
Deterioration

- Cracking
- Delamination
- Eroded Surfaces
- Spalling
- Existing Concrete Repairs
Deterioration Mechanisms

- Thermal Shock
- Erosion
- Corrosion
Railroad Track

- Warped and distorted railroad rail
- Broken and/or missing railroad clips and shims
- Dislodged tie plates with missing or dislodged neoprene bearing pads
- Exposed inverted structural steel channel members due to concrete spalling

Minimize potential for train car derailment by installing spreader bars at regular intervals
Conceptual Repair Schematic
Materials of Construction

- Corrosion Resistance
- Moderate Refractory Properties
- Concrete Mix Design Toughness
- Rapid “Out-gassing” of Mix
- Segmental & P-T Construction Sequencing
Pre-T/A Planning & Design

To Implement a Fast-Track Repair Requires Extensive Preplanning and Incorporation of Proven Construction Technology
Pre-T/A Planning & Design

- The Project Required Rapid Removal and Replacement of the Existing Sluiceway Within a 28 Day “Window of Opportunity”

- The Sluiceway was Critical Path for the Majority of the T/A Schedule
The Planned Repair Approach was to Perform as Much Work as Possible Prior to the Outage and Then Implement Proven Precast Segmental Concrete Construction Along with Rapid Setting Construction Materials.
Precast Concrete Block Segment Fabrication

- Standard Precast Concrete Design with High Performance Concrete Materials
Precast Concrete Block Segment Fabrication

- Use of Metal Formwork and Inserts Assure Proper Alignment of Construction Details During Concrete Placement
Precast Concrete Block Segment Fabrication

- Using a Calcium Aluminate Based Cement Concrete with Stainless Steel Fibers, the Blocks were Placed & Consolidated
Precast Concrete Block Segment Fabrication

- Metal Formwork was Stripped Within 1 Day and the Blocks were Stored in a Cool Location W/O Moist Curing Provisions
Demolition of Existing Sluiceway

- Use of Hydraulic Diamond Wire Cutting Equipment to Remove Massive Subsurface Foundations
Demolition of Existing Sluiceway

- Low Overhead Clearance Hoe Ram Excavators Were Used to Remove Majority of Sluiceway Concrete
Install New Base Slab for Sluiceway

- Installation of a New Double Mat Reinforced 22-inch Thick Base Slab Overtop a Previously Placed Mud-Mat
Install New Base Slab for Sluiceway

- Concrete Placement Using a High-Early Strength Concrete Mix Conveyed via a Concrete Pump Truck
Placement of New Precast Concrete Segments

- Precast 10,500# Concrete Block Segments Placed Sequentially Using a Compact Carry-Deck Crane
Placement of New Precast Concrete Segments

- Drilling and Installation of PT Grouted Anchors Thru Sleeved Precast Blocks into CIP Structural Base Slab
Placement of New Precast Concrete Segments

- Torquing and Stressing PT Anchor Rods to Spec. To Assure Composite Behavior Between Block & Base Slab
Placement of New Precast Concrete Segments

- Precast Concrete Segments Installed and Prior to Joint Grouting, Waterproofing and Backfilling
Successful Project Performed Under Budget and 3 Days Ahead of Schedule