Northeast Bridge Preservation Partnership Meeting

Superstructure Preservation Strategies

Aetna Viaduct Superstructure Repairs
Route I-84 – City of Hartford, CT
State Project No. 63-648

David A. Cutler, P.E.
Supervising Engineer
Consultant Design - Bridge
Sequence of Today’s Presentation

- Present a brief description and rehabilitation history of the Aetna Viaduct
- Discuss the current rehabilitation project
  - Scope
  - Design criteria and sequencing of repairs
  - Construction Issues
  - Photos
Aetna Viaduct

Existing Bridge Description

- So named due to the proximity to the Aetna Life and Casualty Complex to the north.
- Group of five steel multi-girder bridges, Built in 1965
- I-84 over Amtrak Railroad, parking lots and city streets in Hartford, CT
- Three lanes of mainline I-84 through traffic plus various operational exit and entrance ramps
- I-84 eastbound consists of 44 spans (Br. 03160A)
- I-84 westbound consists of 42 spans (Br. 03160B)
- I-84 eastbound on ramp (Sigourney Street) (Br. 03160C)
- I-84 westbound off ramp (Sigourney Street) (Br. 03160D)
- I-84 eastbound (Br. 03301)
Aetna Viaduct Quick Facts

- 5 Bridges
- 111 Spans
- 1926 Beam Ends
- 30 Steel Pier Caps
- 505,000 ft² of Deck Area
- 175,000 Vehicles per Day
- (Highest ADT in Connecticut)
Location Plan
Recent Aetna Viaduct Repair Projects

- Project 63-488 minor steel repairs and pin and hanger retrofit (1992)
- Project 63-503 deck repairs by Maintenance forces (1994)
- Project 63-526 emergency deck repairs (1995)
- Project 63-565 adjacent bridge deck work—parapet modifications (2000)
Condition of Existing Structure

- Steel corrosion
- Reduced load capacity
- Deficient concrete deck slab and bituminous concrete overlay
- Deteriorated bridge deck joints
- Deteriorated drainage system
Impacts of the Current Bridge Condition

- The Bridge Maintenance Department is frequently involved in repairs
  1. Expensive
  2. Time Consuming
  3. Reactive
  4. Traffic Impacts
- Increased potential for highway shutdowns for immediate repairs
- Increased time and effort during bridge inspections to evaluate and document the condition
- Increased rate of deterioration
The Bridge is in need of a near term rehabilitation project to ensure that existing capacity can be maintained during the planning and preparation of a longer term solution.
… an emergency situation exists relative to the physical condition of Bridge No. 03160 A, B, C and D … and Bridge No. 03301 …

Based on recent inspections of the bridge, areas of the bridge deck, superstructure and substructure have been found to be significantly deteriorated and the necessary repairs are beyond the capacity of the Department’s Maintenance forces.

Therefore, I intend to employ, in any manner, such assistance as may be required to repair this structure in order to provide safe conditions and correct the emergency I have so declared.

Dated this 26th day of April, 2008, at Newington, Connecticut.

H. James Boice
Acting Commissioner
State of Connecticut
as: Newington

I, the undersigned, Lisa S. King, have personally appeared, H. James Boice, Acting Commissioner of Transportation of the State of Connecticut, known to me to be the person described in the foregoing instrument, and acknowledged that he executed the same in capacity herein and for the purpose therein contained.

Lisa S. King
Notary Public

My Commission Expires June 30, 2011
Scope of Work for Project No. 63-638

Phase 1 - Perform immediate steel repairs at 25 locations, mill & fill overlay to last through the winter

Phase 2 – Provide design plans to include:

- Clean, repair, and paint local areas of deteriorated structural steel pier caps and stringer ends
- Repair concrete bridge deck
- Replace bridge deck joints
- Replace bituminous concrete wearing surface on deck
Stringer End Repairs

- Section loss spreadsheet generated from latest biennial inspection report - 2006
- 2008 biennial data available after project award in spring of 2009
- Special inspection in fall 2009 for spans over Amtrak
- Additional locations added by construction order
<table>
<thead>
<tr>
<th>Span</th>
<th>Pier</th>
<th>Girder</th>
<th>Girder Type</th>
<th>Web Thickness (ASTM)</th>
<th>Original Web Loss (sq. in.)</th>
<th>North Elev. Web Section Loss Depth</th>
<th>South Elev. Web Section Loss Depth</th>
<th>Web Perforation</th>
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<td>up to 1/16&quot;</td>
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<td>up to 1/16&quot;</td>
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<td>&lt; 5%</td>
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Web Thickness field measured with D-meter. Web repaired along the bottom by adding a plate.
## Spreadsheet Generated by the Designer

<table>
<thead>
<tr>
<th>Span</th>
<th>Pier</th>
<th>Girder</th>
<th>Girder Type</th>
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<th>Original Web Area (in²)</th>
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<th>South Elev. Web Section Loss Depth</th>
<th>Web Pr. for Shear</th>
<th>Web Loss for Bearing</th>
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<td>15.9%</td>
<td>70.0%</td>
<td>Current&lt;50%, Future &gt;100%</td>
</tr>
</tbody>
</table>

*Note: All data is for 03160A Girder Section Loss.*

*Hendey & Hanover, 06/12/2005*
Design Criteria for Stringer End Repairs

Allowable Bearing Stress 0.8Fy=26.4 KSI (Fy=33KSI)

Designer assumed 1/16” future section loss

No Repair Required at locations where present and anticipated section loss yields a bearing stress less than 90% of allowable.

Type “A” Repair (No Jacking Required) Utilized at locations where present section loss yields a bearing stress less than 90% of allowable but will exceed 90% of allowable with additional anticipated section loss.

Type “B” Repair (With Jacking) Utilized at locations where present section loss yields a bearing stress greater than 90% of allowable. Jacking used to relieve excess stress prior to bolting repair plates.
Stringer End Repairs

- Project Contract Plans
  63 Locations
  46 Type “A”, 17 Type “B”

- After Last Construction Order
  109 Additional Locations
  48 Type “A”, 61 Type “B”
Stringer End Repair Sequencing

- Note on plans to perform all stringer end repairs prior to the use of oscillatory compaction equipment for placement of bituminous concrete overlay
Typical Stringer End Repair Prior to Paint
Steel Pier Cap Repairs

- Section loss spreadsheet generated from latest biennial inspection report - 2006
- 2008 biennial data available after project award in spring of 2009
- Special inspection in fall 2009 for spans over Amtrak
- Additional locations added by construction order
### Spreadsheet Generated From Report

#### Table: 3160A-D Pier Cap Flange Section Loss in High Moment Regions and Load Rating Comparison

<table>
<thead>
<tr>
<th>Pier</th>
<th>Bridge</th>
<th>Inv. Index (Min% Remaining x CJM Rating)</th>
<th>Oper. Index (Min% Remaining x CJM Rating)</th>
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<td>ML26</td>
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**Notes:**
- The purpose of the above table is to sort existing steel pier caps for bridges 3160A-D in order of which are likely to control the as-suggested load rating (from most likely to least likely) based on the 1989 CJM to build load ratings and the flange section losses calculated from the 2008 seismic inspection.
- Pier cap spans are numbered from the facade to the median.
- NR = Not Applicable
- N.L. = No Significant Loss
- **BOLDFACE TYPE** = Portions over AMTRAK RR not inspected, Flagman unavailable.

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Connecticut Department of Transportation
Design Criteria for Steel Pier Cap Repairs

- 36 Tons Inventory, 58 Tons Operating
- Used 1996 As-Built Load Ratings supplemented with flange section losses calculated from subsequent inspections to identify repair areas.
- Four Sections Checked—Cantilever (Neg. Moment), Midspan (Pos. Moment), Interior Support (Neg. Moment)
Steel Pier Cap Repairs

- Contract Plans – 22 Pier Caps (35 Repair Locations)
- After Last Construction Order 5 Additional Pier Caps 2 New locations on pier caps already in the project

Connecticut Department of Transportation
Steel Plate Repair Sequence

REPAIR TYPE A - SUGGESTED PROCEDURE

NOTE: TIE PLATES SHALL BE INSTALLED INDIVIDUALLY. TIE PLATE BOLTING SHALL BE COMPLETE PRIOR TO BEGINNING INSTALLATION OF THE ADJACENT PLATE.

1. EXISTING RIVETS IN ONE OF THE AFFECTED GAUGE LINES SHALL BE REMOVED IN GROUPS OF FIVE RIVETS (MAXIMUM).
Typical Pier Cap Repair
Steel Pier Cap ML30B

- After supplemental inspection of spans over Amtrak, Pier Cap ML30B had a negative inventory load rating.
- Top flange width to thickness ratio controls.
- Top flange width assumed to be distance between webs.
- Also checked using top flange width measured between rivet lines (probably more realistic).
- Inventory rating less than 36 Tons.
ML30B Emergency Weekend Repair

- Wednesday design meeting – Restrict Permit Loads
- Thursday meeting with Contractor
- Designer expedited shop drawing review
- Contractor used on-hand material to start immediately and worked through the weekend
- Repair complete early next week
ML30B Work Area
Steel Pier Cap ML30B
Steel Pier Cap ML30B
Concrete Bridge Deck Repairs

- Full depth and partial depth repairs in scope
- Ground Penetrating Radar (GPR) survey done September 2008. This information was included into contract plans
- Contractor was allowed six spans to be milled and repaired at a time (in 14 calendar days, nighttime lane closures only)
- WB started first
- Contractor sequenced repair locations to avoid conflicts with steel repairs and joint replacement
- Deck work is complete, comparison between GPR as-built is pending
Joint Replacement

- Most deck joints asphaltic plug
- Some existing joints were to remain ("plank" joints over original finger joints)
- Contractor unable to perform deck patching adjacent to exposed plank joints due to bituminous ramping (1"/40’ requirement, these joints had to be removed
Existing Plank Joint
Photos
Existing Stringer End
Phase 1 Stringer Repair
Repaired Stringer End
Existing Pier Cap
Repaired Pier Cap
Thank You....

For Your Attention