# 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

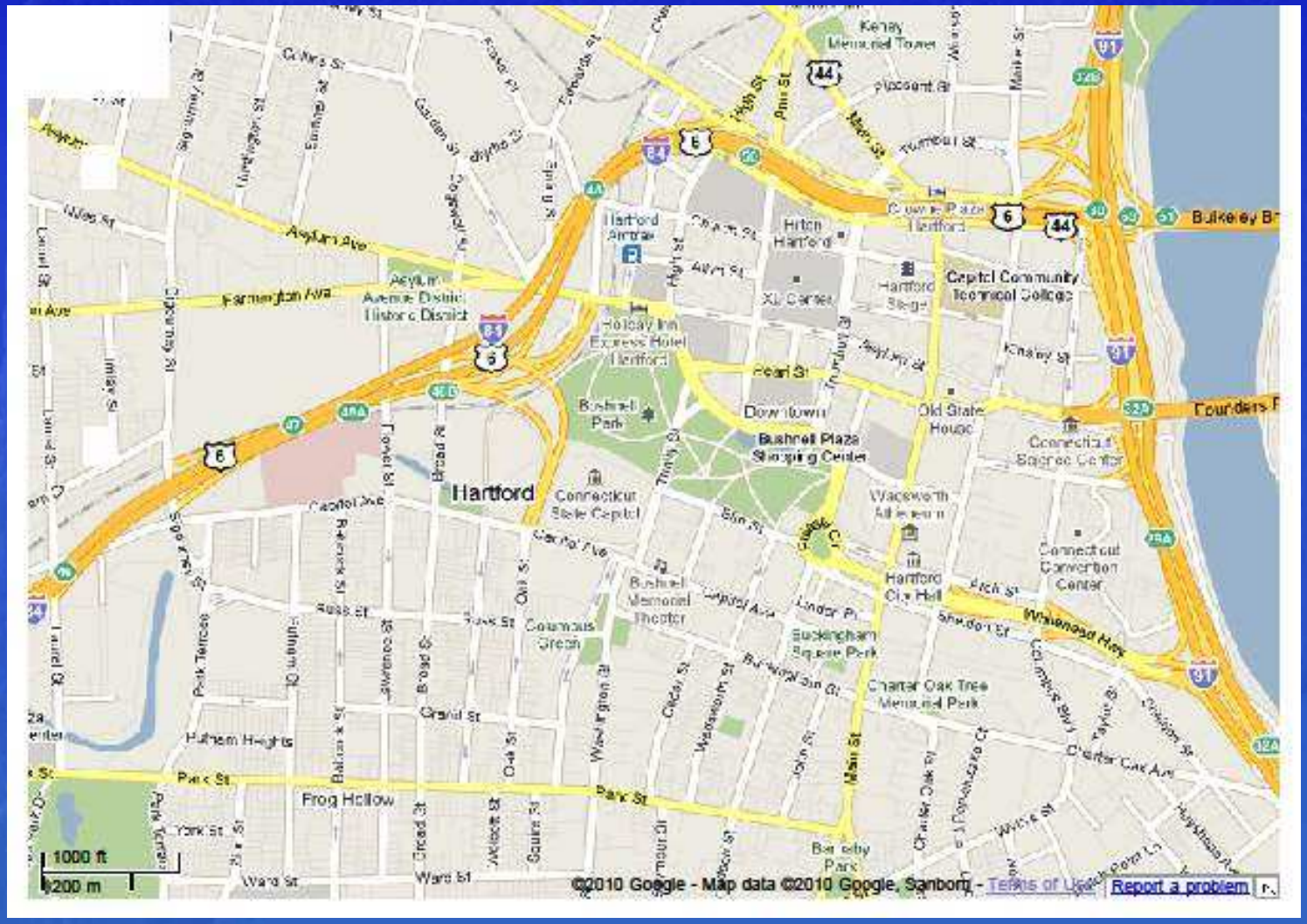
# Aetna Viaduct
# Existing Bridge Description

- 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)

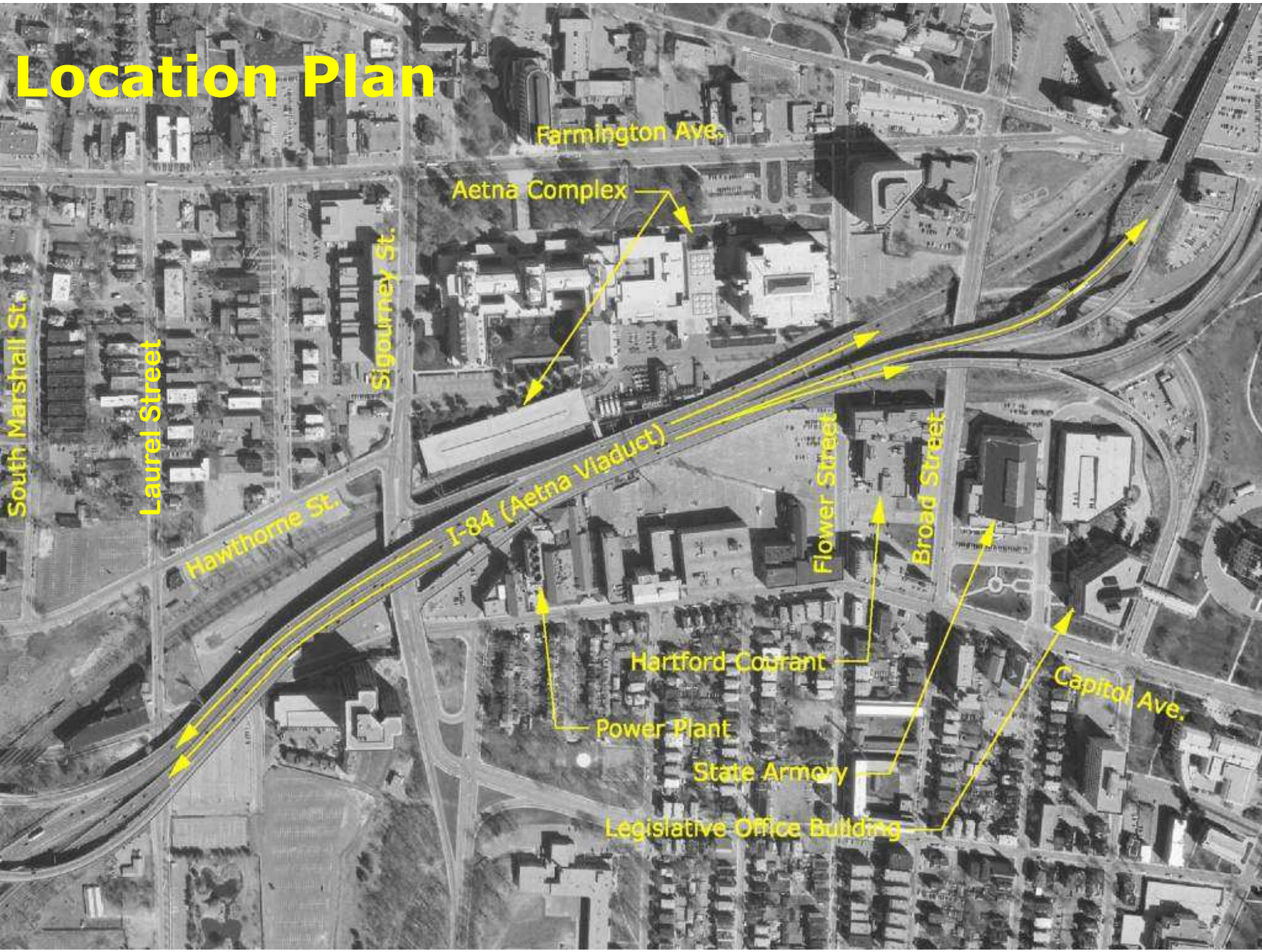
# Aetna Viaduct Quick Facts

- 5 Bridges
- 111 Spans
- 1926 Beam Ends
- 30 Steel Pier Caps
- 505,000 $ft^2$ of Deck Area
- 175,000 Vehicles per Day
- (Highest ADT in Connecticut)

# Location Plan




Connecticut Department of Transportation


Location Plan
Farmington Ave.
Aetna Complex
South Marshall St.
Laurel Street
Sigourney St.
Hawthorne St.
I-84 (Aetna Viaduct)
Flower Street
Broad Street
Hartford Courant
Capitol Ave.
Power Plant
State Armory
Legislative Office Building

# 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

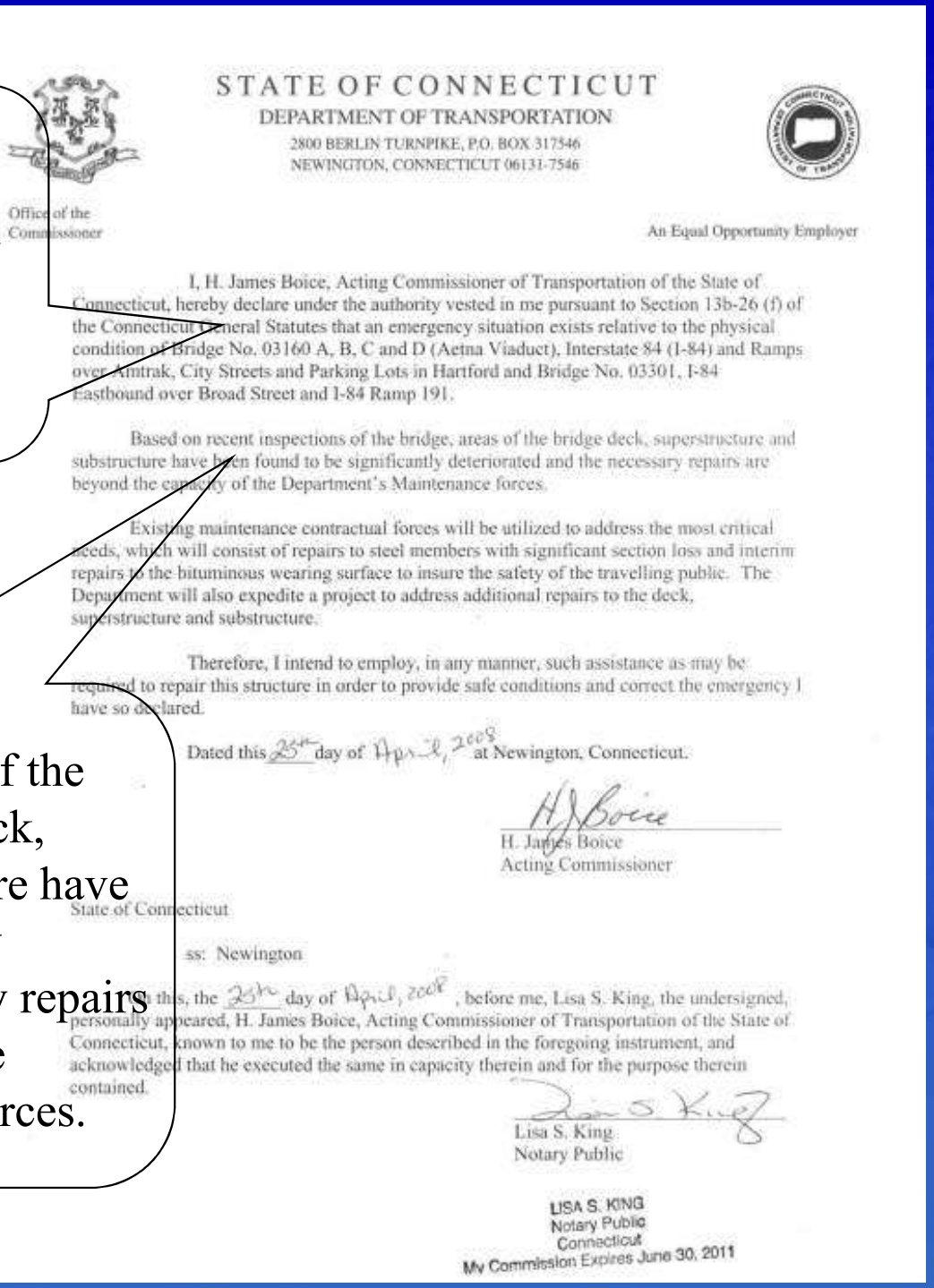
# Impacts of the Current Bridge Condition

- **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.



STATE OF CONNECTICUT
DEPARTMENT OF TRANSPORTATION
2800 BERLIN TURNPIKE, P.O. BOX 317546
NEWINGTON, CONNECTICUT 06131-7546

Office of the Commissioner

An Equal Opportunity Employer

I, H. James Boice, Acting Commissioner of Transportation of the State of Connecticut, hereby declare under the authority vested in me pursuant to Section 13b-26 (f) of the Connecticut General Statutes that an emergency situation exists relative to the physical condition of Bridge No. 03160 A, B, C and D (Aetna Viaduct), Interstate 84 (I-84) and Ramps over Amtrak, City Streets and Parking Lots in Hartford and Bridge No. 03301, I-84 Eastbound over Broad Street and I-84 Ramp 191.

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.

Existing maintenance contractual forces will be utilized to address the most critical needs, which will consist of repairs to steel members with significant section loss and interim repairs to the bituminous wearing surface to insure the safety of the travelling public. The Department will also expedite a project to address additional repairs to the deck, superstructure and substructure.

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 25th day of April, 2008 at Newington, Connecticut.

H. James Boice
Acting Commissioner

State of Connecticut

ss: Newington

On this, the 25th day of April, 2008, before me, Lisa S. King, the undersigned, 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 therein and for the purpose therein contained.

Lisa S. King
Notary Public

LISA S. KING
Notary Public
Connecticut
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

# Spreadsheet Generated From Report

03160A Girder Section Loss Summary

| Span | Pier | Girder | Girder Type | Web Thickness (AISC) | | Original Web Area (sq. in.) | North Elev. Web Section Loss Depth | South Elev. Web Section Loss Depth | Web Perforation | Web Loss for Shear | Web Loss for Bearing | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASE | SE1 | ASE1 | W36 X 160 | 0.650" | 5/8" | 22.08 | 3/16" | 5/16" | | 12.5% | 63.2% | |
| 1SE | SE1 | 1SE1 | W36 X 160 | 0.650" | 5/8" | 22.08 | up to 1/4" | up to 1/4" | | 38.5% | 67.3% | |
| 1SE | SE2 | 1SE1 | W36 X 160 | 0.650" | 5/8" | 22.08 | up to 3/16" | up to 1/4" | | 13.6% | 67.3% | |
| 2SE | SE2 | 2SE1 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 1/4" | up to 5/16" | | 6.5% | 64.9% | |
| 2SE | SE2 | 2SE7 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 1/8" | up to 3/16" | | 1.6% | 40.9% | |
| 2SE | SE3 | 2SE1 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 3/16" | up to 1/4" | | 7.3% | 61.7% | |
| 3SE | SE3 | 3SE1 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 1/4" | up to 1/4" | | 6.5% | 73.5% | |
| 3SE | SE3 | 3SE8 | W36 X 150 | 0.625" | 5/8" | 21.23 | up to 1/4" | up to 3/16" | | | | |
| 3SE | SE4 | 3SE1 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 3/16" | up to 3/16" | | | | |
| 2M | ML3 | 2M10 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 5/16" | up to 5/16" | | | | |
| 2M | ML3 | 2M11 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/8" | up to 1/8" | | < 5% | 32.9% | |
| 2M | ML3 | 2M12 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 3/16" | up to 1/8" | | < 5% | 41.1% | |
| 2M | ML3 | 2M19 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 5/16" | up to 1/4" | | 9.9% | 57.2% | |
| 3M | ML3 | 3M10 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 3/16" | up to 1/4" | | 6.3% | 57.2% | |
| 3M | ML3 | 3M12 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 3/16" | up to 3/16" | | < 5% | 49.0% | |
| 3M | ML3 | 3M13 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/8" | up to 1/8" | | < 5% | 32.9% | |
| 3M | ML3 | 3M14 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/8" | up to 1/8" | | < 5% | 32.9% | |
| 3M | ML3 | 3M19 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 3/8" | up to 3/8" | | 10.1% | 98.0% | |
| 3M | ML4 | 3M10 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 1/4" | up to 1/4" | | 4.3% | 65.4% | |
| 3M | ML4 | 3M12 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/4" | up to 1/4" | | < 5% | 65.8% | |
| 3M | ML4 | 3M13 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/4" | up to 1/16" | | < 5% | 41.1% | |
| 3M | ML4 | 3M14 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/4" | up to 1/8" | | < 5% | 49.3% | |
| 3M | ML4 | 3M19 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 3/16" | up to 3/16" | | 6.3% | 49.0% | |
| 4M | ML4 | 4M9 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 5/16" | up to 5/16" | | 5.4% | 81.7% | |
| 4M | ML4 | 4M18 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 5/16" | up to 1/8" | | 4.2% | 37.8% | |
| 4M | ML5 | 4M9 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 1/4" | up to 5/16" | | 4.6% | 73.5% | |
| 4M | ML5 | 4M18 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 3/8" | up to 5/16" | | 6.0% | 89.9% | |
| 5M | ML5 | 5M9 | W36 X 150 | 0.625" | 5/8" | 21.23 | up to 1/4" | up to 5/16" | | 6.6% | 90.0% | |
| 5M | ML5 | 5M17 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 5/16" | 0" | | 7.6% | 46.0% | |
| 5M | ML6 | 5M17 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 1/4" | up to 1/4" | | 12.6% | 65.7% | |
| 6M | ML6 | 6M17 | W36 X 135 | 0.605" | | 20.76 | up to 5/16" | up to 1/4" | 3"w x 2-1/4"h | 36.0% | OK | Web thickness field measured with D-meter. Web repaired along the bottom by adding a plate. |

# Spreadsheet Generated by the Designer

Original Repair | Additional Repair | Previous Repair (not cor

03160A Girder Section Loss Su

| Span | Pier | Girder | Girder Type | Web Thickness (AISC) | | Original Web Area (sq. in.) | North Elev. Web Section Loss Depth | South Elev. Web Section Loss Depth | Web Pe | Web Loss for Shear | Web Loss for Bearing | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ASE | SE1 | ASE1 | W36 X 160 | 0.650" | 5/8" | 22.08 | 3/16" | 5/16" | | 12.5% | 63.2% | |
| 1SE | SE1 | 1SE1 | W36 X 160 | 0.650" | 5/8" | 22.08 | up to 1/4" | up to 1/4" | | 38.5% | 67.3% | |
| 1SE | SE2 | 1SE1 | W36 X 160 | 0.650" | 5/8" | 22.08 | up to 3/16" | up to 1/4" | | 13.6% | 67.3% | |
| 2SE | SE2 | 2SE1 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 1/4" | up to 5/16" | | 6.5% | 64.9% | |
| 2SE | SE2 | 2SE7 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 1/8" | up to 3/16" | | | | |
| 2SE | SE3 | 2SE1 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 3/16" | up to 1/4" | | 7.3% | 61.7% | Current<90%, Future >100% |
| 3SE | SE3 | 3SE1 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 1/4" | up to 1/4" | | 6.5% | 73.5% | |
| 3SE | SE3 | 3SE8 | W36 X 150 | 0.625" | 5/8" | 21.23 | up to 1/4" | up to 3/16" | | 15.9% | 70.0% | |
| 3SE | SE4 | 3SE1 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 3/16" | up to 3/16" | | < 5% | 55.1% | |
| 2M | ML3 | 2M10 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 5/16" | up to 5/16" | | 9.0% | 81.7% | |
| 2M | ML3 | 2M11 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/8" | up to 1/8" | | < 5% | 32.9% | |
| 2M | ML3 | 2M12 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 3/16" | up to 1/8" | | < 5% | 41.1% | |
| 2M | ML3 | 2M19 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 5/16" | up to 1/4" | | 9.9% | 57.2% | Current>90%; Future >100% |
| 3M | ML3 | 3M10 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 3/16" | up to 1/4" | | 6.3% | 57.2% | Current<90%, Future betw. 90-100% |
| 3M | ML3 | 3M12 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 3/16" | up to 3/16" | | < 5% | 49.0% | Current<90%, Future betw. 90-100% |
| 3M | ML3 | 3M13 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/8" | up to 1/8" | | < 5% | 32.9% | |
| 3M | ML3 | 3M14 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/8" | up to 1/8" | | < 5% | 32.9% | |
| 3M | ML3 | 3M19 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 3/8" | up to 3/8" | | 10.1% | 98.0% | |
| 3M | ML4 | 3M10 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 1/4" | up to 1/4" | | 4.3% | 65.4% | Current<90%, Future betw. 90-100% |
| 3M | ML4 | 3M12 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/4" | up to 1/4" | | < 5% | 65.8% | Current>90%; Future >100% |
| 3M | ML4 | 3M13 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/4" | up to 1/16" | | < 5% | 41.1% | |
| 3M | ML4 | 3M14 | W36 X 230 | 0.760" | 3/4" | 25.37 | up to 1/4" | up to 1/8" | | < 5% | 49.3% | |
| 3M | ML4 | 3M19 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 3/16" | up to 3/16" | | 6.3% | 49.0% | |
| 4M | ML4 | 4M9 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 5/16" | up to 5/16" | | 5.4% | 81.7% | |
| 4M | ML4 | 4M18 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 5/16" | up to 1/8" | | 4.2% | 37.8% | Current<90%, Future betw. 90-100% |
| 4M | ML5 | 4M9 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 1/4" | up to 5/16" | | 4.6% | 73.5% | Current>90%; Future >100% |
| 4M | ML5 | 4M18 | W36 X 194 | 0.765" | 3/4" | 25.99 | up to 3/8" | up to 5/16" | | 6.0% | 89.9% | |
| 5M | ML5 | 5M9 | W36 X 150 | 0.625" | 5/8" | 21.23 | up to 1/4" | up to 5/16" | | 6.6% | 90.0% | |
| 5M | ML5 | 5M17 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 5/16" | 0" | | 7.6% | 46.0% | |
| 5M | ML6 | 5M17 | W36 X 170 | 0.680" | 11/16" | 23.10 | up to 1/4" | up to 1/4" | | 12.6% | 65.7% | |
| 6M | ML6 | 6M17 | W36 X 135 | 0.605" | | 20.76 | up to 5/16" | up to 1/4" | 3"w x 2-1/4"h | 36.0% | OK | Web thickness field measured with D-meter. Web repaired along the bottom by adding a plate. |

Hardesty & Hanover 06/18/2009

# 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

| Inv. Index (Min % remaining x CJM Rating) | Oper. Index (Min % remaining x CJM Rating) | Pier | Bridge |
|---|---|---|---|
| 27 | 47 | ML27 | A |
| 28 | 47 | WBR4 | D |
| 28 | 47 | ES3 | B |
| 29 | 50 | ML31 | B |
| 31 | 49 | ML18 | D |
| 31 | 54 | WBR3 | D |
| 32 | 55 | ML27 | B |
| 32 | 55 | WBR2 | D |
| 33 | 56 | ML24 | B |
| 33 | 56 | ML28 | A |
| 35 | 59 | ML28 | B |
| 36 | 62 | ML31 | A |
| 37 | 62 | ML23 | B |
| 37 | 62 | ML19 | B |

**3160A-D PIER CAP FLANGE SECTION LOSS IN HIGH MOMENT REGIONS AND LOAD RATING COMPAR**

| Ranking | Pier | Bridge 3160_ | Continuous Cap (Shared) (Y/N) | Cantilever Neg. moment | | Midspan 1 Pos. moment | | Interior support Neg. moment | | Midspan 2 Pos. moment | | Span Lengths (feet) | | | | Worst Case Section Loss | Minimum Percent Remaining | As-Built CJM Ratings, 19 (Tons) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Top Flange | Bot. Flange | Top Flange | Bot. Flange | Top Flange | Bot. Flange | Top Flange | Bot. Flange | N. Cantilver | Span #1 | Span #2 | S. Cantilever | | | Inventory | Operati | | | |
| 1 | ML27 | A | Y | 3.4% | N. L. | 23.7% | <3% | 3.6% | N. L. | N/A | N/A | N/A | 56 | N/A | 12.5 | 23.7% | 76.3% | 36 | 61 | | | |
| 2 | WBR4 | D | N | 32.1% | 4.1% | 32.6% | 9.0% | N/A | N/A | N/A | N/A | 16 | 18 | N/A | N/A | 32.6% | 67.4% | 41 | 70 | | | |
| 3 | ES3 | B | N | 35.1% | N. L. | 4.7% | 7.0% | N/A | N/A | N/A | N/A | 16 | 48 | N/A | 5 | 35.1% | 64.9% | 43 | 72 | | | |
| 4 | ML31 | B | Y | 24.6% | N. L. | 28.8% | 5.3% | 14.3% | 9.9% | N/A | N/A | 9 | 46.5 | N/A | N/A | 28.8% | 71.2% | 41 | 70 | | | |
| 5 | ML18 | D | Y | 31.9% | <3% | 30.4% | <3% | N/A | N/A | N/A | N/A | 16 | 17 | N/A | N/A | 31.9% | 68.1% | 45 | 72 | | | |
| 6 | WBR3 | D | N | 23.4% | 7.5% | 23.0% | <3% | N/A | N/A | N/A | N/A | 16 | 18 | N/A | N/A | 23.4% | 76.6% | 41 | 70 | | | |
| 7 | ML27 | B | Y | N/A | N/A | **10.2%** | **<3%** | **2.6%** | **N. L.** | N/A | N/A | N/A | 78 | N/A | N/A | 10.2% | 89.8% | 36 | 61 | | | |
| 8 | WBR2 | D | N | 21.0% | <3% | 19.3% | N.L | N/A | N/A | N/A | N/A | 16 | 18 | N/A | N/A | 21.0% | 79.0% | 41 | 70 | | | |
| 9 | ML24 | B | N | 8.5% | N. L. | 3.2% | <3% | 11.9% | 3.0% | 17.0% | N. L. | N/A | 71 | 30 | 4.5 | 17.0% | 83.0% | 40 | 67 | | | |
| 10 | ML28 | A | Y | N/A | N/A | 16.9% | N. L. | 4.8% | N. L. | N/A | N/A | N/A | 62.5 | N/A | N/A | 16.9% | 83.1% | 40 | 67 | | | |
| 11 | ML28 | B | Y | N/A | N/A | **11.9%** | **N. L.** | **8.5%** | **<3%** | N/A | N/A | 6 | 70 | N/A | N/A | 11.9% | 88.1% | 40 | 67 | | | |
| 12 | ML31 | A | Y | 11.9% | N. L. | **7.0%** | **N. L.** | 11.9% | 4.3% | N/A | N/A | N/A | 67 | N/A | 20 | 11.9% | 88.1% | 41 | 70 | | | |
| 13 | ML23 | B | N | N/A | N/A | 9.4% | N. L. | 6.4% | <3% | 9.4% | N. L. | N/A | 71 | 40 | 3.5 | 9.4% | 90.6% | 41 | 68 | | | |
| 14 | ML19 | B | N | 25.5% | N. L. | 16.4% | N. L. | N/A | N/A | N/A | N/A | 16 | 63 | N/A | 16 | 25.5% | 74.5% | 50 | 83 | | | |
| 15 | SE3 | A | N | 9.4% | N. L. | 15.2% | 6.6% | 12.9% | 5.4% | 4.7% | N. L. | 7 | 48 | 20 | 7 | 15.2% | 84.8% | 45 | 76 | | | |
| 16 | ML25 | B | N | 10.4% | N. L. | **9.5%** | **6.2%** | N/A | N/A | N/A | N/A | N/A | 73 | N/A | 23.5 | 10.4% | 89.6% | 43 | 72 | | | |
| 17 | ML25 | A | N | 14.1% | <3% | 10.5% | N. L. | 27.2% | <3% | 28.4% | <3% | 8 | 37 | 37 | N/A | 28.4% | 71.6% | 54 | 90 | | | |
| 18 | WE3 | A | N | N/A | N/A | 16.7% | N. L. | 14.1% | N. L. | **10.8%** | **8.2%** | N/A | 39 | 69 | N/A | 16.7% | 83.3% | 47 | 77 | 39 | 64 | WE3 | A |
| 19 | ML20 | A | N | 27.2% | 6.5% | 21.7% | 3.5% | 22.3% | 3.5% | 9.4% | N. L. | 4 | 37 | 37 | N/A | 27.2% | 72.8% | 54 | 90 | 39 | 66 | ML20 | A |
| 20 | WE2 | A | N | 20.4% | N. L. | **10.0%** | **3.2%** | N/A | N/A | N/A | N/A | 19 | 69 | N/A | N/A | 20.4% | 79.6% | 50 | 83 | 40 | 66 | WE2 | A |
| 21 | ML3 | A | Y | 12.9% | N. L. | N/A | N/A | 12.7% | 3.1% | 27.2% | 8.3% | N/A | 25.5 | 63 | 7.5 | 27.2% | 72.8% | 56 | 94 | 41 | 68 | ML3 | A |
| 22 | ML3 | B | Y | 23.4% | N. L. | N. L. | N. L. | N. L. | 5.8% | 27.2% | 10.3% | 8.5 | 29 | 63 | N/A | 27.2% | 72.8% | 56 | 94 | 41 | 68 | ML3 | B |
| 23 | ML19 | A | N | N/A | N/A | N. L. | N. L. | N. L. | N. L. | 9.4% | <3% | N/A | 38 | 38 | N/A | 9.4% | 90.6% | 45 | 76 | 41 | 69 | ML19 | A |
| 24 | ML30 | A | Y | N/A | N/A | 10.2% | 10.6% | 9.6% | 3.4% | **16.4%** | **N. L.** | N/A | 30.5 | 73 | N/A | 16.4% | 83.6% | 49 | 81 | 41 | 68 | ML30 | A |
| 25 | ML24 | A | N | 22.9% | N. L. | 5.3% | <3% | 8.2% | N. L. | 11.2% | N. L. | 9 | 37 | 37 | N/A | 22.9% | 77.1% | 54 | 90 | 42 | 69 | ML24 | A |
| 26 | ML30 | B | Y | N/A | N/A | 14.3% | 4.4% | 10.7% | 3.7% | **14.0%** | **6.2%** | N/A | 34.5 | 73 | N/A | 14.3% | 85.7% | 49 | 81 | 42 | 69 | ML30 | B |
| 27 | EBR5 | C | N | N/A | N/A | 19.0% | N. L. | N/A | N/A | N/A | N/A | N/A | 39.5 | N/A | N/A | 19.0% | 81.0% | 54 | 90 | 44 | 73 | EBR5 | C |
| 28 | ML26 | A | N | 35.4% | <3% | 23.9% | N. L. | N/A | N/A | N/A | N/A | 20.5 | 40 | N/A | 9 | 35.4% | 64.6% | 68 | 113 | 44 | 73 | ML26 | A |
| 29 | WE1 | A | N | N/A | N/A | **6.4%** | **N. L.** | N/A | N/A | N/A | N/A | N/A | 68 | N/A | N/A | 6.4% | 93.6% | 47 | 77 | 44 | 72 | WE1 | A |
| 30 | ML23 | A | N | 11.4% | 5.9% | 17.6% | 3.3% | 10.6% | N. L. | 14.0% | <3% | 9 | 37 | 37 | N/A | 17.6% | 82.4% | 54 | 90 | 44 | 74 | ML23 | A |
| 31 | ML21 | A | N | 14.0% | <3% | 4.6% | <3% | 16.4% | <3% | 15.3% | <3% | 6 | 37 | 37 | N/A | 16.4% | 83.6% | 54 | 90 | 45 | 75 | ML21 | A |
| 32 | ML5 | A | N | 19.7% | <3% | 25.0% | 8.5% | N/A | N/A | N/A | N/A | 9 | 39 | N/A | 19.5 | 25.0% | 75.0% | 61 | 101 | 46 | 76 | ML5 | A |
| 33 | ML20 | B | N | 14.0% | N. L. | 22.0% | 5.0% | N/A | N/A | N/A | N/A | 16 | 54 | N/A | 17 | 22.0% | 78.0% | 59 | 101 | 46 | 79 | ML20 | B |
| 34 | ML22 | A | N | 14.0% | 3.5% | <3% | N. L. | 4.7% | N. L. | <3% | N. L. | 8 | 37 | 37 | N/A | 14.0% | 86.0% | 54 | 90 | 46 | 77 | ML22 | A |
| 35 | ML22 | B | N | 10.6% | N. L. | 7.7% | N. L. | N/A | N/A | N/A | N/A | 22 | 36 | N/A | 17 | 10.6% | 89.4% | 52 | 88 | 46 | 79 | ML22 | B |
| 36 | ML21 | B | N | 16.4% | N. L. | 9.4% | N. L. | N/A | N/A | N/A | N/A | 18 | 45 | N/A | 17 | 16.4% | 83.6% | 56 | 94 | 47 | 79 | ML21 | B |
| 37 | ML4 | A | N | 19.6% | <3% | 14.4% | <3% | N/A | N/A | N/A | N/A | 10.5 | 63 | N/A | N/A | 19.6% | 80.4% | 59 | 101 | 47 | 81 | ML4 | A |
| 38 | ML29 | B | Y | 11.7% | <3% | **4.0%** | **5.6%** | N/A | N/A | N/A | N/A | 20 | 72.5 | N/A | N/A | 11.7% | 88.3% | 54 | 90 | 48 | 79 | ML29 | B |
| 39 | ML29 | A | Y | N/A | N/A | 8.3% | <3% | 8.4% | N. L. | **N. L.** | **N. L.** | N/A | 55 | 72.5 | N/A | 8.4% | 91.6% | 54 | 90 | 49 | 82 | ML29 | A |
| 40 | ML18 | A | Y | 16.4% | N. L. | 16.4% | N. L. | N. L. | N. L. | N. .L | N. L. | 19 | 45 | 43.5 | N/A | 16.4% | 83.6% | 61 | 103 | 51 | 86 | ML18 | A |
| 41 | ML26 | B | N | 7.8% | N. L. | **3.0%** | **N. L.** | N/A | N/A | N/A | N/A | N/A | 71.5 | N/A | 16 | 7.8% | 92.2% | 59 | 99 | 54 | 91 | ML26 | B |
| 42 | EBR6 | C | N | 5.0% | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 39.5 | N/A | 7.5 | 5.0% | 95.0% | 58 | 97 | 55 | 92 | EBR6 | C |
| 43 | ML2 | B | N | N/A | N/A | 4.1% | N. L. | N/A | N/A | N/A | N/A | N/A | 65 | N/A | N/A | 4.1% | 95.9% | 61 | 103 | 58 | 99 | ML2 | B |
| 44 | ML1 | B | N | 3.6% | N. L. | 8.9% | N. L. | N/A | N/A | N/A | N/A | 20 | 40 | N/A | N/A | 8.9% | 91.1% | 65 | 106 | 59 | 97 | ML1 | B |
| 46 | EBR4 | C | N | 5.0% | <3% | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 22 | N/A | 9 | 5.0% | 95.0% | 95 | 155 | 90 | 147 | EBR4 | C |

**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-inspected load rating (from most likely to least likely) based on the 1996 CJM as-built load ratings and the flange section losses calculated from the 2008 biennial inspection.

Pier cap spans are numbered from the fascia to the median.
N/A = Not Applicable
N. L. = No Significant Loss

**BOLDFACE TYPE = Portions over AMTRAK RR not inspected, Flagman unavailable.**

# Design Criteria for Steel Pier Cap Repairs

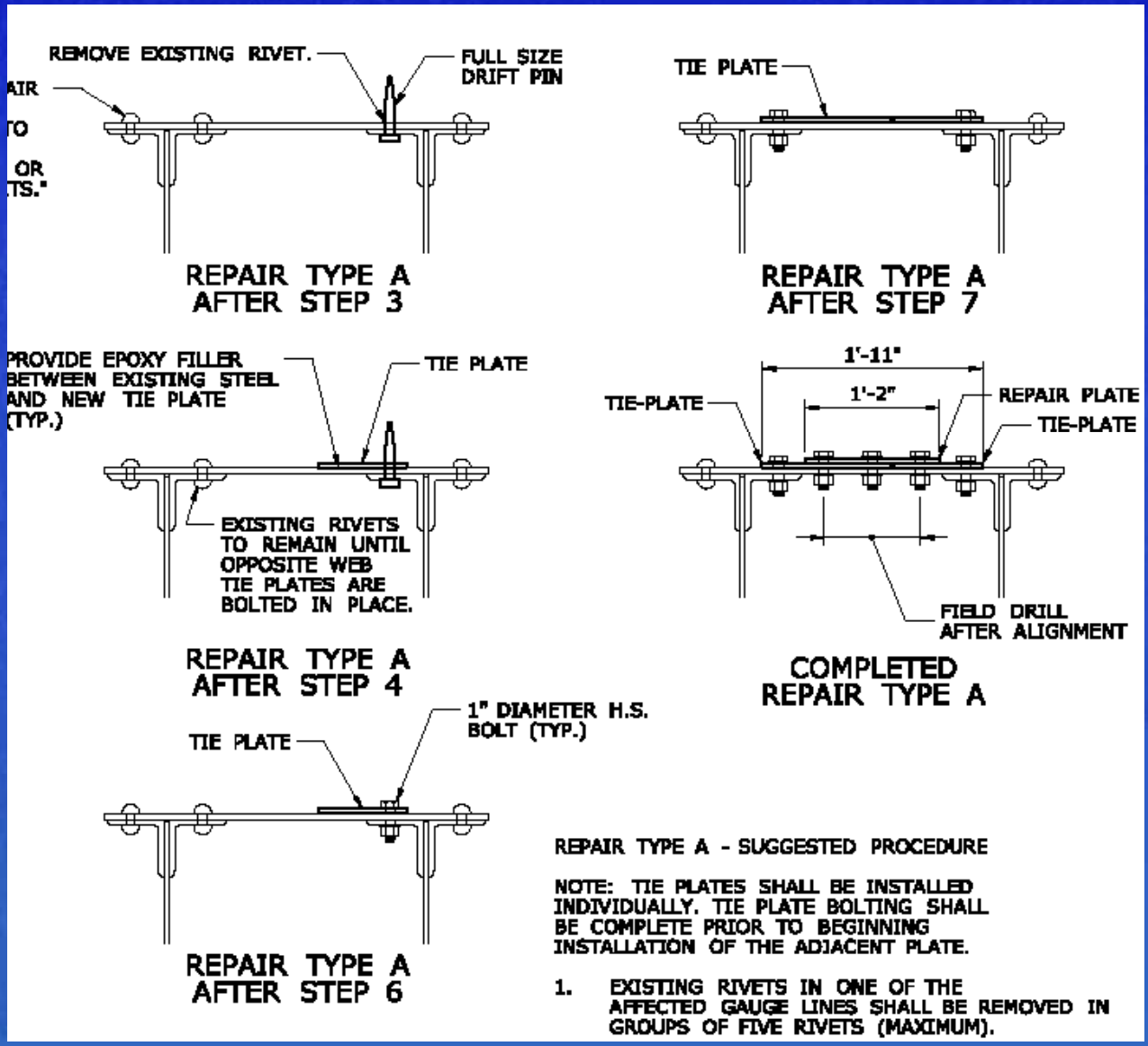
- 36 Tons Inventory, 58 Tons Operating
- Used 1996 As-Built Load Ratings supplemented with flange section losses calculated from subsequent inspections to identify repair areas.
- Four Sections Checked– Cantilever (Neg. Moment), Midspan (Pos. Moment), Interior Support (Neg. Moment)

# 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**

# Steel Plate Repair Sequence



# 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-builts 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