Emergency Repair to the Delaware River Turnpike Bridge

Pennsylvania

New Jersey

Delaware River
GENERAL INFORMATION:

Year Built: 1956
Designer: George S. Richardson
Contractor: American Bridge
Structure Type: 6,571’, 31 Spans
Main Span – Continuous Arch Truss (682’ Main/341’ anchor)
Approach – 3/4 Span Continuous Deck Truss, girder/floorbeam
Over: PA US Route 13, Amtrak Mainline, 3 Local Roads in PA,
Delaware River, River Road in NJ
ADDITIONAL INFORMATION:

- **ADT (2014):** 41,551
- **Last Inspection:** 2016
- **Structure Painting Contract Currently in Progress.**
- **Ownership:** Jointly Owned by New Jersey Turnpike Authority and Pennsylvania Turnpike Commission.
REHABILITATION HISTORY:

• Initiated Annual Deck rehab – 1991
• Replacement of Deck on PA Side – 1998 to 2001
• Replacement of Deck on NJ Side – 2005 to 2006
• Truss Hardening – 2009
• Repainting of the Truss and Seismic Retrofit – 2016 to 2018
14 Similar Deck Truss Spans of 31 Total Spans
Bridge Length Potentially Affected: 2/3 Mile of 1 1/4 Miles

PA Cont. Deck Truss Spans:
- 3 Span Continuous Unit: Piers 10 – 13
  Total Length ≈ 647’
- 4 Span Continuous Unit: Piers 13 – 17
  Total Length ≈ 1078’

NJ Cont. Deck Truss Spans:
- 3 Span Continuous Unit: Piers 24 – 27
  Total Length ≈ 647’
- 4 Span Continuous Unit: Piers 20 – 24
  Total Length ≈ 1078’
LOCATION OF FRACTURE

4 Span Continuous Deck Truss Unit (Spans 14 to 17)
Day 1: January 20, 2017

- On-Going Paint Contract – Discovered by Contractor
- Immediate Action - Remove Traffic on and below bridge.
- Notify both State’s DOTs and agencies and municipalities
- Utilize General Consultant Engineers
- Organize Teams/Resources – Contractors and Consultants were either working onsite or recently on site
- Clearing the Unit of Contractor Material
- Determine extent of damage to the unit/determine cause
- Stabilize Truss
Day 1 cont’d: Organize Teams/Resources

- Alternatives – Repair or Replace unit?
- Set Up Communication Center at Site as well as communication channels with PTC and NJTA Offices
- Daily meetings/calls and reporting
- Utilize resources already on site or in vicinity
- Input from Contractors and Supervision personnel would be incorporated into the repair details
- Personnel from both agencies on site
- Loss Revenue = Sense of Urgency
Major Decisions

• Repair truss based on elastic truss behavior
• Inspect and monitor truss displacement during repairs
• Perform non-destructive testing
• Perform load tests on the bridge
• Open the bridge to traffic after the repairs
• Long term monitoring of all the deck truss spans
And The Next 48 Days...

- Public Outreach
- Building Confidence
Hands-On Inspection

Other Completed Actions – Hands-On Inspection of Similar Units

3-Span Continuous Deck Truss

NJ 4-Span Continuous Deck Truss Unit on 1/27/2017
NJ 3-Span Continuous Deck Truss Unit on 1/30/2017
PA 3-Span Continuous Deck Truss Unit on 2/3/2017

Legend: Inspection Focus
- “Jumbo” Tension Member (Flange Thickness > 1 1/2”)
- “Jumbo” Compression Member (Flange Thickness > 1 1/2”)
Ultrasonic Testing
UT Results

• Scanned flanges 3 feet out from edge of gussets on every tension and reversal member in PA and NJ.
• Scanned full length of 42 tension members.
• No additional mis-drilled holes filled with weld material found.
• However, when you look, you will find things...
Indication at U7-U9 on PA 3-SPAN
Indication at U7-U9 on PA 3-SPAN
Indication at L6-L8
PA 4-SPAN
Summary/Conclusions of UT

- 277 members tested 3 ft. each end/Full length 42 tension members
  - Zero plug weld indications
- Removed chord scanned prior to delivery to Lehigh. No other plugs present
- Some odd mechanically filled holes.
- One location (U7-U9) cored and tested multiple ways. No evidence of any rejectable defects.
- Believed to be the largest field NDT project ever conducted.
- Results provided confidence along with other project activities to reopen the bridge.
Material Testing
Material Study Observations

• Identified steel as USS Man-Ten (A242)
  • More carbon and manganese than the original A242 standard

• Lowest toughness for mid-thickness samples in flanges greater than 1.5 in. thick

• Steel has lower toughness than modern steels, but is consistent with typical steels of the era

• Material is sufficient for use in the bridge as originally intended, i.e. a mechanically-fastened structure with no welds
Material Conclusions

• Fracture caused by weld-filled holes which were the result of a fabrication error during construction

• Timing due to increases in dead load over life of the bridge, presence of temporary painting platforms, low temperature, and other factors

• Material in bridge is similar to material from same time period, not prone to fracture if welding is avoided
Questions?