Emergency Repair to the Delaware River Turnpike Bridge

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 spans
Over: PA US Route 13, Amtrak Mainline, 3 Local Roads IN PA,
Delaware River, River Road in NJ

ADDITIONAL INFORMATION:
• ADT (2014) = 41,551
• Ownership/Maintenance: Jointly Owned by New Jersey Turnpike Authority and Pennsylvania Turnpike Commission
• Last Inspection: 2014
• 2016 Inspection currently in progress.
• Structure Painting Contract Currently in Progress.
3 Span Continuous Unit: Piers 10 – 13
Total Length ≈ 647'

4 Span Continuous Unit: Piers 13 – 17
Total Length ≈ 1078'

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)
On-Going Paint Contract – Discovered by Contractor

Immediate Action
- Remove Traffic on and below bridge.
- Clearing the Unit of Contractor Material
- Stabilize Truss
- Alternatives
- Organize Teams/Resources

Day 1: January 20

- Set Up War Rooms at Site as Well as PTC Central Office
- Communications – Daily Meetings/Calls – Multiple Times a Day
- Utilize Agencies’ General Consultant Engineers
- Utilize Resources Already on Site or in Area
  - Allied Painting
  - Cornell and Co.
  - STV
  - Urban
  - PKF
- PTC Presence on Site
STABILIZE TRUSS
Install Temporary Support Towers
Summary of UT

- 277 members tested. 3 ft. limits each end
- Zero plug weld indications
- Removed chord scanned prior to delivery to Lehigh. No other plugs present
- 53 additional members identified for full length testing. No defects found.
- Suspected “mechanically filled holes” confirmed that “no welds” present.
- UT-U9 cores tested multiple ways. No evidence of any rejectable defects
BEST SCENARIO:
- Confirmation that this is an isolated finding
- Material testing across entire structure does not show global issue
- The structural members move as predicted during slow, regulated jacking
- Sensors installed during instrumentation and analysis show that stresses shift in existing members to acceptable levels during jacking
- Permanent splice is installed
- Complete repairs; load test
- Open the bridge to traffic
**Going Forward**

- On-going Repairs
- Restoration of Site
- Removal of Towers
- Recreation of Basins
- Forensic Analysis
- Long Term Health Monitoring
- Bridge Replacement
- Challenges and Positives

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**Purdue - Material Testing**

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**Purdue – Material Testing**

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INITIAL CONCLUSIONS

- Brittle fracture initiated and propagated from holes repaired/partially filled with weld material.
- No evidence of fatigue damage observed in initiation areas.
- The weld HAZ may have increased the susceptibility to brittle crack initiation.
- Five of six samples tested met the yield and tensile strength requirements.
- Test results indicate the material is as-expected for the era of construction.
- Cracking observed along inclusions near the mid-surface of the flange:
  - May have formed during welding or fracture.
  - Oriented perpendicular to the fracture.
- CVN values, when taken per the A673 specifications, appear more than adequate for steels of the era.
- CVN values can vary depending on where they were taken: those near the surface tend to have higher toughness than those near mid-thickness.
- Test results indicate the material is as-expected for the era of construction.
- Appropriate yield stress to use based on the material tests to date would be 42 ksi.
- Material shows good ductility.

Delaware River Turnpike Bridge

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<td>Lehigh University</td>
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