Design of PennDOT’s First Self-Propelled Modular Transporter Bridge Move: SHALER STREET BRIDGE

February 9, 2021

LOUIS RUZZI, PE
Former District 11 Bridge Eng.
PennDOT

MATTHEW COCHRAN, PE
Senior Structural Engineer
Lochner
Advantages to ABC, Pitching to Design

- Reduced construction costs
  - Construction Inspection Staff Time
  - MPT Rentals
- Increased Safety
  - Reduces need for construction over/adjacent to live traffic
- Improved Quality
  - Better quality control for shop fabricated elements
  - Phased construction can result in reduced quality due to multiple phased joints, tight work areas, and traffic impacts
Evolution of ABC in District 11

- Accepting change, ABC becoming more widely applied
- Initially select pilot projects on low volume/low risk projects
- Apply lessons learned to more complex/high volume projects

- Consider opportunities to promote ABC to public using user cost savings resulting from reduced construction time

- Some DOT’s have evolved to develop formal decision-making tools (CTDOT ABC Decision Matrix – available on website)
Partial History of District 11’s ABC

- **2014 | Full Replacement Pre-fabricated Elements w/ Integral Abutments**
  - SR 288 Wampum (7-day closure)

- **2016 | Single Weekend Superstructure Replacement**
  - SR 30 (57 hours)

- **2017 | Slide-in (PA Turnpike) Place Bridge Construction**
  - PA Turnpike, full bridge replacement (2-day closure)

- **2018 | Slide-in (Small Scale) Place Bridge Construction**
  - SR 208 (5-day closure, 10-hour bridge slide)

- **2019 | Self-Propelled Modular Transporter (SPMT) Move**
  - Shaler Street Bridge (2-day closure for demolition & 2-day closure for placement)

- **2020 | Accelerated Pre-Cast Box Culvert Replacements**
  - SR 88 (2 box culverts replaced in 6 days each)

- **2023 | Slide-in Place Bridge Construction**
  - Tentatively planning 800-foot long-span delta-frame on I-376 (ADT 100,000+)
Flow of Design

**TIMELINE**

<table>
<thead>
<tr>
<th>Scoping</th>
<th>Prior to Prelim. TS&amp;L</th>
<th>PE and Final Design</th>
<th>Prior to Letting</th>
</tr>
</thead>
</table>

**COORDINATION MEETINGS**

- **ABC Determination**
  - **Involved:**
    - DOT: ADE, Bridge Engineer, Structure Control (SCE), and ACE
    - Design Team

- **Pro Team Meeting**
  - **Involved:**
    - DOT: Bridge Engineer, SCE, and ACE
    - Design Team

- **Design, Construction, & Traffic Meeting**
  - **Involved:**
    - DOT: Bridge Engineer, SCE, Constructability Review Manager (CRM), and ACE
    - Design Team

- **Constructability Reviews (30%, 60%, 90%)**
  - **Involved:**
    - DOT: SCE, CRM, ACE, and IIC
    - Design Team

- **Pre-Bid Meeting**
  - **Involved:**
    - DOT: ADE, Bridge Engineer, Structure Control (SCE), and ACE
    - Design Team

- **Letting**
  - **Involved:**
    - DOT: Bridge Engineer, SCE, CRM, ACE, IIC, and Contract Management
    - Design Team
    - Bidding Contractors

- **ABC Constructability Review Meeting (60%)**

*Unique to SR 19/Shaler Street*
Shaler Street (4,849 ADT) passes over SR 19 (27,000 ADT), connecting Pittsburgh to I-376, I-79 and the Pittsburgh International Airport.

**Project Award**
- Bid: September 2018
- Low Bid: $3.66 Million
- Substantial Completion: December 2019

**PRESENTER:**
Louis Ruzzi, PE
Former PennDOT
ABC in Pennsylvania

Received a $400,000 grant from FHWA to implement ABC.

Location Selection Criteria:
- Overhead structure
- Urban setting
- Available staging area(s)
- Many utilities
## Shaler Street Bridge – Cost Comparison

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Bridge Cost w/ABC</strong></td>
<td>$3,700,000</td>
</tr>
<tr>
<td><strong>Estimated Cost w/out ABC</strong></td>
<td>$2,950,000</td>
</tr>
<tr>
<td><strong>Additional Cost Due to ABC</strong></td>
<td>$750,000</td>
</tr>
<tr>
<td>(includes bridge staging area preparation, temporary abutments, SPMT rentals, move path preparation, and all associated engineering costs)</td>
<td></td>
</tr>
<tr>
<td><strong>Net Savings – Savings to Traveling Public (Non-DOT $)</strong></td>
<td>$2,200,000</td>
</tr>
<tr>
<td>(when compared to the additional ABC costs due to the reduction in traffic restrictions/detour duration resulting from ABC: Days Saved x User Cost - Additional ABC Costs)</td>
<td></td>
</tr>
</tbody>
</table>
Existing Shaler Street Bridge

• Built in 1949
• 162 feet long by 35 feet wide (two 6’ sidewalks, 24’ wide roadway)
• Three span structure (Span 1 – 60’, Span 2 – 56’, Span 3 – 42’)
• Two abutments and two piers
• Profile Grade 14%

Proposed Shaler Street Bridge

• 34’ 5” wide (one 5’ 8” sidewalk, 26’ wide roadway)
• Two span structure (spans 70’ each)
• Five steel plate girders, concrete deck
• AASHTO M270/M270M Grade 50 Steel
• Two abutments and one pier
• Profile Grade 14%
Goals of the Project

- Maximize use of SPMTs
- Minimal impact to SR 19 (2-day closure for demolition & 2-day closure for SPMT move)
- Construct bridge as quickly as possible
- Build as much as possible before demolition
- Public outreach - Animation
Designer Perspective

PRESENTER:
Matt Cochran, PE
Lochner
Feasibility Analysis

- RULD savings/user cost savings
- Reached out to heavy move contractors
- Available space for a bridge staging area
- Convey intent to contractors and inspection staff
Soil Nail Wall & Geotechnical

- Soil nail wall needed because Abutment 2 was built under existing bridge

Substructure Choices

- Construction under traffic
  - Pier located under bridge, reconstructed after demolition
  - Abutment 1 location fixed due to available move path width
Pier Design

- Need a pier that could be constructed quickly following demolition
- Limited cure time prior to bridge move
- Evaluate constructing foundations prior to demolition
- Weight of cap dictated column location
- Caissons drilled after demolition of existing pier and located to avoid existing footers
- Key elements included:
  - Pre-cast pier columns and cap
  - Simple for Dead, Continuous for Live Connection for steel beams at pier

Initial Caisson Locations

Final Caisson Placement
Farming Bridges

• Temporary abutments
  • Used LARSA model to analyze bridge during move and determine tolerances

• Agreement and discussions with staging area property owner to determine needs for access

• Transition from Bridge Farm to the move path
• Evaluated move path for horizontal clearances and grade changes
• Discussions with heavy move contractors during design to determine feasibility

• Included center-of-gravity of spans on plans for heavy move contractor to determine stability of overall system
• Each span weighs approximately 260 tons
Anticipated Challenges

• ¼ inch deck grinding/mechanical grinding
• Bridge monitoring system (during bridge move)
• Contingency plan
• Move path – clearance envelope
• Coordination with Heinz Field events
Connecting Design & Construction

Meet with ACE & Inspector In Charge
- Meet during design
- Discuss intent of project, potential risks, and incorporate input from construction into design (year in advance of letting)

Constructability Review
- Seek input from Construction prior to PS&E

Apply Lessons Learned
- Production rates, construction methods, and closure times

Expert Opinion
- Consulted heavy move contractors during design

Execute Project
- Demonstration project for SPMTs – alternates not permitted
Questions?

Louis Ruzzi, PE
Former PennDOT

Matt Cochran, PE
Lochner
Thank You