Concrete Arch Bridge Rehabilitation Challenges

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PennDOT Districts 4-0 & 5-0
Rehabilitation vs. Replacement?

- Purpose & Need
- Condition

- Long crossings-rehab can be more cost-effective
- Small structures-often in rural areas, low ADT

SR 4018 over the former NR-eligible Delaware, Lackawanna & Western Railroad, Lackawanna County
Penn Street Viaduct at Reading, Pennsylvania

Replacing a Steel Viaduct by a Concrete Structure on the Same Center Line without Serious Interruption to Traffic over the Old Bridge

A reinforced concrete viaduct 1350 ft. long by 80 ft. wide is being built at Reading, Pa., under rather unusual conditions. The structure when completed will carry Penn Street across the Schuylkill River, the canal of the Schuylkill Navigation Company, the Schuylkill division of the Pennsylvania Railroad and two branches of the Philadelphia & Reading Railroad, and will replace a steel bridge at present serving that purpose.

The old steel structure is of the Pratt of 110-ft. span and nine of 48-ft. span. At the east end there is a reinforced concrete approach supported on columns, while the arches at the west end connect directly with the street grade.

The center line of the new bridge coincides with that of the old one and one of the problems of construction was to build the new structure without seriously interfering with traffic on the old one. The situation was further complicated by the three sections spread footing of widths varying with the conditions. Both end sections are pointed as shown in the illustrations, the upstream section in each case being equipped with an ice breaker. Between these sections heavy reinforced concrete curtain walls 2 ft. thick are built. These extend from the tops of the footings to the springing line of the arches, thus giving the construction the appearance of a solid pier. This design was adopted partly to prevent shearing of masonry in case of future gouge of appearance.

The pier sections are each 1-in.

STRUCTURAL SYSTEM

- Reinforcement bars
- Concrete
- Arches
- Spandrel columns
Identify character-defining features

Substructure

Decorative Elements

- obelisks
- alcoves
- piers
- parapet walls
Protect and Maintain

• Protection: Consideration of effects via 106, 4(f) & State History Code
• Maintenance: Regular inspections but little money for cyclical preservation activities
• Small repairs by PennDOT workforce

Standard 2: The historic character of a property shall be retained and preserved.

Standard 5: Distinctive features, finishes, and construction techniques or examples of craftsmanship that characterize a historic property shall be preserved.
Standard 6. Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and other visual qualities and, where possible, materials.
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Repair or Replace Features In-Kind

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How did it go so wrong?

• Little built-in accountability and consequences
• Inspector unwilling to say no
• Lack of communication
• Special provisions not detailed enough
• Inexperience

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• Partnered with Chemistry Unit, Construction & Materials Lab Testing Section
• Color meter readings on good/bad colors
• Provided a range of colors within a certain delta-all in the same color family
• Goal: Quantifiable difference
Repair or Replace Features In-Kind

For the concrete cast-in-place or precast railing, cast and west approaches, and pylons and pilasters:

PennDOT will provide the contractor with a Federal Standard color as a guide for the anticipated color family as well as a polygon with the acceptable color range. A liquid color additive will create a concrete color similar to the color of the existing railing and pylons and pilasters. These elements will be finished.

Guidelines:

- The approach remains the same as the original.
- The color will match the existing.
- The polygon will be used to ensure the color is within the acceptable range.
- If the color does not match, corrective action will be taken.

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Standard 6. Replacement of missing features shall be substantiated by documentary, physical, or pictorial evidence.
Design of Missing Features

- Have documentation of original obelisks
- Consulting party coordination led to consideration of reconstruction
- Not possible—current lighting requirements would change proportions and spacing of obelisks
- Would obstruct reconstruction of overlooks
- Conclusion after discussion re: hierarchy of character-defining features
- Compromise achieved—one set reconstructed

Penn Street Bridge, Reading

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SR 78 over Schuylkill River (1955), Hamburg, Berks County
Lessons Learned

• The Standards are there to help. Use them. Share them with your project team, including the contractor and inspectors.

• Make special provisions work for you. Be specific and thorough.

• Work with Construction to develop enforceable consequences for work that doesn’t meet expectations. Define those expectations in the special provisions and ensure they are reasonable.

• Meet with the contractor and inspectors periodically, even if you don’t have specific work to review.

• A contractor who is held to a standard with consequences will likely give you a good product.
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