Proposed AASHTO Guide Specifications for Historic Bridge Preservation – Ballot Item Background

AASHTO Webinar
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Background

Some Bridge Preservation Issues

• Owners face challenges in balancing cultural values and functional performance when scoping historic bridge projects.

• Specifications could provide consistency and guidance on appropriate level of service for site and intended use.

• Commonly accepted practices are ok for ordinary situations, but sometimes need adjustments to adequately serve preservation needs. For example:
  • Load rating – Often a less conservative refined load rating can still err on the side of safety and allow for more preservation options.
  • Unknown foundations – Sometimes a reasonable degree of testing and analysis can provide an approach that still errs on the side of safety and allows for more preservation options.
  • Scour – Sometimes a scour critical bridge with a long history of good performance can be kept in service with scour protection or scour monitoring.
Background

Some Additional Bridge Preservation Issues

• Specifications could provide a means of sharing information on innovative technology.

• “State of practice” varies with level of support and experience with historic resources.

• Owners face challenges with estimating the cost of preservation work and justifying historic preservation decisions.

• Owners face challenges with quantifying environmental and traffic impacts and justifying historic preservation decisions.

• Owners face challenges with “scope of employment” for bridge preservation designers, related to the designer’s potential personal liability. These challenges can dampen innovation and bias decision-making against otherwise reasonable preservation options.
Background
Purpose & Need

• Document:
  • “State of practice”.
  • Innovative technology.
  • Situations where commonly accepted practices don’t adequately serve preservation needs, and solutions.
  • “Scope of employment” for bridge preservation designers, to reduce their personal liability.

• Inform:
  • Management of bridge preservation programs.
  • Delivery of bridge preservation projects.
  • Ability to maintain safety while preserving historic assets.
  • Understanding of cost savings sometimes available with preservation.
  • Understanding of reduction in environmental and traffic impacts sometimes available with preservation.
Background
Creation of the Guide Specifications

• Attempt to follow LRFD Specifications format as much as possible.

• Address design standards for preservation work and effective interactions with regulatory bodies and other stakeholders.

• Introduce “Intended Level of Service”, a level of service that is adequate for the reasonably expected use of the bridge in a particular site and situation, but may not meet all contemporary standards.

• Initial draft started from ODOT perspective.

• Second draft incorporated comments from a number of states and FHWA.

• Final draft incorporated comments from AASHTO T9 Technical Committee on Bridge Preservation.
Summary
Section 1- Introduction

• Historic significance as relates to Federal statues (Section 4(f) and Section 106).

• Intended Level of Service.

• Economics.
Summary
Section 2- General Design and Location Features

• Design objectives.

• Traffic needs.

• Roadway, railroad, and navigation clearance needs.

• Foundation investigation.

• Scour.
Summary
Section 3- Loads and Load Factors

• Load factors.

• Loads:
  • Live Loads
  • Wind Loads
  • Earthquake
  • Earth pressure

• Temporary works.
Summary
Section 4- Structural Analysis and Evaluation

• Structural analysis.
• Load rating.
• Physical testing.
Summary

Section 5 – Concrete Structures

• Durability.

• Evaluation of existing concrete.

• Repair technologies:
  • Concrete anchors
  • Concrete patching
  • Strengthening by section enlargement
  • Bonded strengthening
  • External post-tensioning
  • Supplemental supports
  • Internal shear anchors
  • Member replacement
  • Epoxy crack injection

• Prestressed and post-tensioned structures.

• Concrete coatings.
Summary

Section 6 – Steel and Iron Structures

• Durability.

• Evaluation of existing iron & steel.

• Fatigue and fracture.

• Gusset plates.

• Repair technologies:
  • Fasteners
  • Welding
  • Steel repairs and strengthening
  • Heat straightening
Summary
Section 6 – Steel and Iron Structures (Continued)

• Repair technologies (Continued):
  • Member replacement
  • Wrought iron repairs
  • Cast iron repairs

• Vertical clearance improvement.

• Suspension bridges.
Summary
Section 7 – Aluminum Structures

• Durability.
Summary
Section 8 – Timber Structures

• Durability.

• Covered bridges.

• Timber substructures.
Summary
Section 9 – Decks and Deck Systems

• Concrete decks.

• Timber decks.

• Steel decks.

• Fiber reinforced polymer (FRP) decks.
Summary
Section 10 – Foundations

• Scour repairs.

• Foundation reuse, i.e. how to constructively address unknown foundations.

• Underwater repairs.
Summary
Section 11 – Walls, Abutments, and Piers

• Retaining structures.
Summary
Section 12 – Buried Structures and Tunnel Liners

• Durability.

• Load rating for unreinforced buried arches.
Summary
Section 13 – Railings

• Alternatives for treatment of historic rails:
  • In-kind rail repairs.
  • Rail retrofits.
  • “Stealth” rail.
  • Crash-worthy “historic look” rail
  • “Ornamental” rail.
  • Stone masonry railings.

• Deck overhang design.
Summary
Section 14 – Joints and Bearings

• Expansion joints.

• Bearings.

• Seismic retrofits.
Summary
Section 15 – Masonry

• Masonry repair.

• Load rating for unreinforced masonry arches.
Examples

Coos Bay (McCullough Memorial) Bridge

The bridge was designed under the direction of Oregon’s renowned State Bridge Engineer Conde B. McCullough in a six month period in 1933 and named for McCullough in 1947.
Examples

Coos Bay (McCullough Memorial) Bridge

Ever-larger reinforced concrete deck arches raise the roadway to match the gracefully curved cantilever truss above the navigation channel.
Examples
Coos Bay (McCullough Memorial) Bridge

Graceful lines and art deco-style detailing were used throughout to produce a stunningly beautiful bridge.
Examples
Coos Bay (McCullough Memorial) Bridge

Constructed from August 1934 through June 1936, cost $2.1 Million and 2 worker fatalities.
Examples
Coos Bay (McCullough Memorial) Bridge

Part of a large Public Works Administration project which eliminated 5 ferries at bay and river crossings on the Oregon Coast Highway. The 5 new bridges were constructed at Newport, Waldport, Florence, Reedsport, and North Bend (Coos Bay).
Examples
Coos Bay (McCullough Memorial) Bridge

The bridge exists within 3 miles of the Pacific Ocean. Marine salt damages the structural steel by providing an electrolyte and a catalyzing effect for corrosion.
Examples

Coos Bay (McCullough Memorial) Bridge

Marine salt damages the reinforced concrete by providing electrolyte and a catalyzing effect for corrosion of reinforcement which in turn causes spalling of concrete.
Examples
Coos Bay (McCullough Memorial) Bridge

Schematic of impressed current cathodic protection. Low-voltage direct current passes from the zinc coating on the reinforced concrete surface to the reinforcement, driving corrosion to occur at the zinc coating rather than the steel.
Examples
Coos Bay (McCullough Memorial) Bridge

Impressed current cathodic protection includes work platforms and containment. A rigid frame work platform and containment system is shown with its heating and ventilating system. Enclosures made with flexible materials like tarps are more economical.
Examples
Coos Bay (McCullough Memorial) Bridge

Impressed current cathodic protection includes visual inspection and sounding of concrete to identify spalled or delaminated areas.
Examples
Coos Bay (McCullough Memorial) Bridge

Impressed current cathodic protection includes removal of spalled and delaminated concrete
Examples
Coos Bay (McCullough Memorial) Bridge

Impressed current cathodic protection includes repair of damaged reinforcing bars.
Examples
Coos Bay (McCullough Memorial) Bridge

Impressed current cathodic protection includes establishing electrical continuity between all reinforcing bars.
Examples
Coos Bay (McCullough Memorial) Bridge

Impressed current cathodic protection includes concrete patching.
Examples
Coos Bay (McCullough Memorial) Bridge

Impressed current cathodic protection includes abrasive blast surface preparation followed by arc-sprayed zinc coating of the concrete surfaces.
Examples
Coos Bay (McCullough Memorial) Bridge

Impressed current cathodic protection includes installation of anode terminal plates.
Examples
Coos Bay (McCullough Memorial) Bridge

Since 2002 ODOT has been installing “stealth” railings on historic coastal bridges. The appearance of the original rail is replicated and strength is improved by embedding structural steel.
Since the 1990s ODOT has been installing life-safety performance level seismic retrofits (keep superstructure seated on substructure) on historic coastal bridges. The bearing seats are extended, rocker-type bearings are replaced with elastomeric pads, lateral shear blocks are added, and longitudinal cables tie the spans together.
Examples
Coos Bay (McCullough Memorial) Bridge

Existing small-diameter drains are replaced with 8 inch diameter PVC drains with modern inlets.
Examples
Coos Bay (McCullough Memorial) Bridge

Roadway wearing surface is renewed with 3/4 inch thick premixed/screeded polyester polymer concrete over methacrylate primer, and expansion joint seals are replaced or retrofitted.
Examples
Coos Bay (McCullough Memorial) Bridge

The bridge is currently being recoated, Bid $31.4 Million.
Examples
Coos Bay (McCullough Memorial) Bridge

The south approaches of the bridge received impressed current cathodic protection between 2007 and 2012. This project included coating repairs resulting from 2001 project, cathodic protection, Phase 1 seismic retrofit, larger bridge drains, “stealth” rail, expansion joint seal replacement, and sealing/overlay of wearing surface. Construction cost $30.0 Million.
Examples
Coos Bay (McCullough Memorial) Bridge

The north approaches of the bridge received impressed current cathodic protection in a project that finished in 2018. This project included cathodic protection, Phase 1 seismic retrofit, expansion joint seal replacement, and larger bridge drains. “Stealth” rail and overlay were completed by change orders on the 2007-2012 project. Bid $22.9 Million.
Examples
Coos Bay (McCullough Memorial) Bridge

- Preservation of a historic landmark.
- Aesthetic value to the community.
- Reduced traffic impacts.
- Reduced environmental impacts.
- Good stewardship of public funds:
  Approx. Replacement Cost $750 Million (2 lanes, 100 yr. design)
  $30,600,000 per year annualized at 4% interest

Rehabilitation Cost – Painting and ICCP every 20 yr.
$3,741,000 per year annualized at 4% interest.
Examples

Coos Bay (McCullough Memorial) Bridge
The Yamhill River Bridge was constructed in 1939 at a cost of $47,000 using accelerated bridge construction (ABC) principles. This historic photo shows the 70-ton earlier structure just before moving onto temporary piers using rollers and hand winches.
Examples

Yamhill River (Sheridan) Bridge

The Yamhill River Bridge is listed as a category 2 historic resource (potentially eligible for National Register of Historic Places). It had been considered for replacement due to deteriorating condition, but cost and the impacts to traffic and the community made replacement less attractive than preservation. This bridge is the link between each half of Sheridan, and the site has significant urban characteristics.
Examples
Yamhill River (Sheridan) Bridge

The Yamhill River Bridge was recoated with 24-hour flagging and a lane closure.
Examples
Yamhill River (Sheridan) Bridge

The Yamhill River Bridge received steel repairs, steel truss strengthening, concrete repairs, life-safety performance level seismic retrofit, and shear studs connecting deck and stringers.
Examples
Yamhill River (Sheridan) Bridge

The Yamhill River Bridge received pedestrian and traffic rail improvements and a polymer concrete overlay which included the sidewalks. The only full closure of the bridge was two Saturday nights to place two lifts of the overlay. Work included replacement of expansion joint seals.
Examples
Yamhill River (Sheridan) Bridge

The Yamhill River Bridge received scour protection.
Examples
Yamhill River (Sheridan) Bridge

- Preservation of a historic resource.
- Aesthetic value to the community.
- Significantly reduced traffic impacts.
- Reduced environmental impacts.
- Good stewardship of public funds:
  Approx. Replacement Cost $8.5 Million (2 lanes, 100 yr. design)
  $347,000 per year annualized at 4% interest

  Rehabilitation Cost – $1.7 Million rehab 30 yr. life
  $98,000 per year.
Examples

Yamhill River (Sheridan) Bridge
Conclusions

- Historic bridge preservation can enhance cultural value and be cost-effective.

- Historic bridge preservation can appropriately use bridge-specific criteria, i.e. Intended Level of Service.

- Specific technologies can make historic bridge preservation effective and practical.
Questions?
Thank you.