Project R19A Service Life Design for Bridges

Implementation Assistance Program (IAP) – Update to AASHTO SCOBS Technical Committee T-9 on Bridge Preservation

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Topics

• R19A Project Background/Team
• Service Life Design Overview
• Implementation Assistance Program
  – Who? – Participants
  – What? – Projects
  – When? – Schedule
• Next Steps
What are SHRP2 Solutions? – Over 100 Research Projects

What is R19A?
- Comprehensive guidance to select and design durable bridge systems and components that are both easier to inspect and better-suited to their environments.

The Service Life Design Method for Bridges may be utilized to provide longer service life by design through durable and state-of-the-art materials, construction techniques, and utilization of emerging technologies that are ideally suited for the bridge.
R19A Research Project

• Bridges for Service Life beyond 100 Years: Innovative Systems, Subsystems & Components


– Research Agency: University of Nebraska – Lincoln
– Principal Investigator: Atorod Azizinamini
– Effective Date: 12/21/2007
– Completion Date: 12/31/2013
Bridges for Service Life Beyond 100 Years
Innovative Systems, Subsystems, and Components

http://www.trb.org/Main/Blurbs/169729.aspx
R19A – Design Guide

Design Guide for Bridges for Service Life

PREPUBLICATION DRAFT • NOT EDITED

SHRP 2 Renewal Project R19A

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

strategies for highway research, innovation, and technology

• http://www.trb.org/Main/Blurbs/168760.aspx
Who Are We?

- **RESEARCH** – TRB
- **IMPLEMENTATION** – FHWA/AASHTO
- **SUBJECT MATTER EXPERTS / LOGISTICS** – CH2M HILL
- **TECHNICAL SME’s** – Buckland and Taylor
Bridge Design has historically been focused primarily on structural engineering aspects:

- Selecting materials by their strength properties (f’c, fy) and sizing components to resist loads.
- Extremely important, but does little to ensure that a structure will remain in use for a given period of time.
Service Life Background

• When a structure reaches the end of its life

  – The cause is primarily because the material components have begun to deteriorate

• Not from unanticipated loads

• But by loss of strength from steel corrosion and concrete cracking/spalling, as a result of the environmental exposure conditions
Significant research has been completed over the past 25 years on how materials deteriorate with time (particularly reinforced concrete).

Mathematical models have been developed to model deterioration.

Service Life Design provides a means for designing for durability based on deterioration from the environmental exposure.
Environmental Exposure
Deterioration

- Reinforced Concrete Deterioration Mechanisms
  - Reinforcing Steel Corrosion due to:
    - Chloride Ingress
    - Carbonation
  - Concrete Deterioration due to:
    - Freeze-Thaw
    - Abrasion
    - Alkali-Silica Reaction (ASR)
Deterioration

• Structural Steel
  – Corrosion after Breakdown of Protective Coating Systems
• Confederation Bridge, Canada – 1997 (100 years)
Service Life Designed Structures

- Gateway Bridge, Brisbane – 2010 (300 years)
Service Life Designed Structures

- Ohio River Bridge, KY – 2016 (100 years)
Service Life Designed Structures

- Tappan Zee Bridge, NY – 2018 (100 years)

courtesy of New York State Thruway Authority
SHRP2 R19A Targeted Bridges

• Representing the majority of the 600,000+ Bridges in the US
• Goals
  – Promote Service Life Design Concepts
    • Marketing, Outreach & Training
    • Target 15% of State DOTs by 2016
  – Produce Basic Elements for Inclusion in an AASHTO Service Life Design Guide
    • Coordinate with SCOBS and T-9
  – Build a Strong Technical Foundation
    • Training & Reference Materials
    • Lessons Learned Summaries
SHRP2 IAP – Assistance Types

Proof-of-Concept Pilot

Lead Adopter

User Incentive
30 IAP Bridge-Related Projects Underway

- NDT for Bridge Decks
- PBES/ABC
- Service Life Design
- Other Bridge-Related
R19A IAP Funding

- State Agencies were awarded Lead Adopter grants of $150,000
- FHWA CFL was awarded $75,000
- Funding for technical assistance from the SME team is through SHRP2, and **NOT** part of agency grants
What are the Lead States Doing?

- Iowa
  - 4-span bridge over I-29 near Sioux City
    - ASTM A1010 Stainless Structural Steel
    - Life Cycle Cost Analysis
    - Corrosion loss predictions from salt spray generated by truck traffic (not part of R19A)
  - Dual I-35 Bridges over Skunk River near Ames
    - 1st Bridge let in Jan 2016 – traditional design
    - 2nd Bridge scheduled for Jan 2018 – to deploy R19A Service Life Design methods
    - Provides side-by-side comparison example
What are the Lead States Doing?

• Oregon
  – Existing Bridges
    • Collect data on bridge preservation activities performed
    • Identify costs, benefits, added remaining life due to actions
  – Review and revise Design-Build RFP criteria for Service Life Design requirements for the I-5 Columbia River Crossing
  – New Bridge from the 2017 Construction Program
    • Perform R19A Service Life Design
    • Project not yet selected
What are the Lead States Doing?

• Pennsylvania
  – Identify recently constructed bridge to “reverse engineer”
    • Collect as-constructed material data
    • Perform further testing to fill in data gaps
    • Analyze structure using Service Life Design principles
    • Determine what could have been done differently to achieve a longer service life
    • Project not yet selected
What are the Lead States Doing?

- Virginia
  - New bridge design example (structure type not yet selected)
    - Select environment along coast or with heavy de-icing salts
    - Life Cycle Cost Analysis of lower grade corrosion resistant reinforcement with higher durability concretes versus high end stainless reinforcement
What are the Lead States Doing?

- **FHWA Central Federal Lands**
  - Replacement of existing remote access one-lane bridges on the coast of Kauai
  - On-site testing plan (coring) of existing structures for chloride content
  - Material testing program
    - Current standard mix designs
    - New mix designs
  - Perform Service Life Design
Next Steps - What can you do?

• Look for tools from the Implementation Program

• Next Round of Implementation Assistance
  – User Incentive Offering in Round 7 in early 2017
  – Instructions for application on the GO SHRP2 website

http://www.fhwa.dot.gov/goshrp2/ImplementationAssistance

Look for instructions and applications at the SHRP2 website
  – User Incentives
Questions?

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http://www.fhwa.dot.gov/goSHRP2/
http://shrp2.transportation.org