Service Life Design of Bridges (R19A)

TO	Pam Hutton, SHRP2 Implementation Manager
COPY	Sam Rosenblum, Program Manager Patricia Bush, Product Lead
DATE	April 22, 2019
PREPARED BY	Mike Bartholomew, Subject Matter Expert Team Lead
REGARDING	Implementation Close Out of SHRP2 Product: Service Life Design of Bridges (R19A)

Overview

This summary report includes the following sections:

- Purpose of Product (initial goals)
- Participants (States engaged in IAP or other)
- Overview of Product Activity - Executive Summary
- Output (Deliverables)
- Outcomes
- Benefits
- Web Links
- Appendix A – List of Key Agency Participants
- Appendix B – Webinar Agenda
- Appendix C – Peer Exchange Agenda and Participants List

Purpose of Product (initial goals)

The Federal Highway Administration (FHWA), in partnership with the American Association of State Highway and Transportation Officials (AASHTO), is responsible for implementing the tools and products delivered by the Transportation Research Board (TRB) under the SHRP2 program. Under TRB, the R19A SHRP2 project "Bridges for Service Life Beyond 100 Years: Service Life Design for Bridges" delivered a comprehensive design guide for improving the service life of bridges. As one of a number of SHRP2 products that focuses on renewal of the Nation's transportation infrastructure, the "Design Guide for Bridges for Service Life" (commonly referred to as the "Guide") provides agencies with the framework, guidelines, and solutions to optimize the service life performance of new and existing bridges or bridge components.

Successful implementation of Service Life Design for Bridges is generally defined within the R19A Implementation Plan as "…integrating service life design concepts and technologies within everyday practice." To establish a strong and enduring foundation for service life design within the U.S. bridge community, the following three implementation goals were identified:

(1) Promote service life design concepts and technologies by building national awareness of Service Life Design through both a broad marketing and training effort and a formal "Implementation Assistance Program" (IAP) targeting use and integration within at least 15% of state transportation agencies by 2016;

(2) In coordination with the AASHTO Subcommittee on Bridges and Structures (SCOBS) – and in particular, the T9 Bridge Preservation technical committee – produce a Summary Guide publication; and

(3) Recognizing that broad integration of service life design principles within national bridge programs may take several to many years to fully implement, strive to develop a strong foundation for the continued application of service life design by delivering pressing technology deployment needs during implementation assistance (e.g., worked reference examples, professional and academic training materials, "lessons learned" summaries, a searchable web-Guide, supporting design procedure and policy documents).

Participants

American Association of State Highway Transportation Officials (AASHTO)

Pam Hutton, SHRP2 Implementation Manager

Patricia Bush, Product Lead

Federal Highway Administration (FHWA)

Matt DeMarco (6/2014 – 7/2016), Raj Alainey (7/2016 – 4/2019), Implementation Leads

Subject Matter Expert (SME) Team

Jacobs Engineering Corporation (formerly CH2M HILL)

Mike Bartholomew

COWI North America (formerly Buckland & Taylor)

Ann-Marie Langlois, Brad Pease, Neil Cumming

IAP Agencies (see Executive Summary below)

Overview of Product Activity - Executive Summary

- The objective of Service Life Design of Bridges is to complete a rational assessment of the potential deterioration mechanisms affecting bridges and their elements to achieve a target service life duration. This approach goes beyond sole reliance on current code-based prescriptive requirements that may not sufficiently consider site-specific environmental exposure conditions and/or performance requirements. To best implement service life design in a new bridge project, aspects of the service life design process should be appropriately implemented from project outset (that is, during the planning and inception phase) and during all project stages during the planning, design, construction, and operation phases. The R19A IAP guides the Lead Adopter agencies on how to follow this process.
- The product was made available via Round 4 in Fall 2014, and Round 7 in Summer 2016. Five (5) agencies submitted applications for Round 4 and two (2) agencies submitted for Round 7. All proposers were selected.
- Participating Agencies / Project Leads and Project Descriptions

  <u>Round 4</u>

  - Federal Highway Administration – Central Federal Lands Highway Division (CFL) / Bonnie Klamerus
    - Three (3) single lane replacement bridges for the Hawaii DOT in a remote coastal marine environment on the north shore of the island of Kauai. The bridges span fresh water streams within 1,000 ft from the ocean. CFL is implementing Service Life Design principles

on concrete members to resist corrosion of reinforcing steel due to chloride ingress. Worked with University of Hawaii to perform testing for chloride migration properties on Hawaii DOT standard mix designs. Also cored existing bridges and developed chloride profiles and measured salinity of the streams to evaluate chloride loading.

- Iowa Department of Transportation (IaDOT) / Ahmed Abu-Hawash
  - Bridge subjected to extreme de-icing spray exposure using ASTM A1010 corrosion resistant structural steel on 2 girders of a 6-girder system. Performing lab and field testing for steel corrosion resistance performance. Evaluation will continue beyond end of R19A project.
  - Dual Bridge replacements on I-35 over South Skunk River near Ames. SB bridge designed and constructed in 2016 following Iowa DOT standards with High-Performance Concrete (HPC) deck and epoxy coated reinforcement. NB Bridge designed and constructed in 2018 with HPC deck and stainless-steel reinforcement using Avoidance of Deterioration approach. Construction cost of the bridge with stainless-steel deck was 10% higher, however life cycle costs
- Oregon Department of Transportation (ODOT) / Bruce Johnson
  - Simple span prestressed concrete bridge in central Oregon over Ochoco Creek in a de-icing environment designed for 100-year service life. Performed testing for chloride migration properties of Oregon DOT standard mix designs and chloride profiles of existing bridge deck to evaluate chloride loading.
  - Chloride Deck Corrosion Study. Core-drilled decks and developed chloride profiles on bridges throughout the state. Used results to determine statewide chloride exposure zones to de-icing chemicals.
  - Developed a design and construction criteria for Service Life Design to be used in an RFP for Design/Build and other Alternative Delivery projects.
- Pennsylvania Department of Transportation (PennDOT) / Tom Macioce
  - Sub-contracted work with Lehigh University to perform over two-hundred (200) durability tests for chloride migration coefficients on PennDOT standard concrete classes for prestressed beams, substructure concrete, deck concrete and barrier concrete. Studied effects of water-cement ratio, supplemental cementitious materials, coarse and fine aggregate types on the properties.
- Virginia Department of Transportation (VDOT) / Prasad Nallapaneni
  - Investigation of Advancement in Materials. VDOT has had a policy to use Corrosion Resistant Reinforcement since 2008 and Low (or no) Crack Concrete Mix since 2016. They are using R19A to understand new developments in Service Life enhancements. Collected concrete samples from bridges under construction and performed chloride migration tests. Compared historical data on de-icing chloride loadings of bridge decks to the calculation method used in *fib* Bulletin 34. Developed six (6) climate/environmental loading regions. Performed Service Life calculations on case study bridge, placing it in each of the regions to evaluate performance.

<u>Round 7</u>

- Iowa Department of Transportation (IaDOT) / Ahmed Abu-Hawash

        - Evaluation of Thin Deck Overlays on six (6) structures along US-18 corridor, three with epoxy and three (3) with low slump concrete overlays. Field investigations of overlay bonding effectiveness. Laboratory accelerated freeze-thaw and salt ponding testing for chloride penetration on the overlays.
    - Maine Department of Transportation (MDOT) / Dale Peabody
        - Jonesport-Beals Bridge replacement, one of Maine's "Forever Bridges" from the mainland to Beals Island on the ocean. Bridge is subjected to both a marine and deck de-icing environment. Goal was to use a combination of Design to Resist Deterioration and the Avoidance of Deterioration approaches. Cored the existing bridge pier at multiple locations to develop chloride profiles and resulting chloride surface loading versus elevation. Also tested construction mix designs for chloride migration coefficients to perform a full probabilistic design on concrete elements with carbon steel reinforcement.
- CFL was awarded $75,000, and the state agencies were each awarded $150,000 of financial assistance, all as Lead Adopters.

Output

Project Deliverables from Scope of Work

- Task 2.1 Development of Training and Reference Materials
    - Task 2.1a – Developed On-Site Training presentations for Service Life Design Introduction and Service Life Design to *fib* Bulletin 34 – Model Code for Service Life Design.
    - Task 2.1b – Framework Design Guidance – Service Life Design Summary Guide. The Summary Guide consolidates the design process from the initial 700+ page document, Design Guide for Bridges for Service Life produced during the research phase of project R19A. A flowchart for the Service Life Design process describes the key steps to be taken during planning, design, construction and operation of a bridge. The Summary Guide describes the environmental actions that cause deterioration of bridges and the methods of mitigation that can be applied. It identifies the two major Service Life Design strategies; Avoidance of Deterioration, and Design to Resist Deterioration, which is further divided into Deemed-to-Satisfy, Full-Probabilistic, and Partial Factor methods. The Summary Guide includes six Appendices:
        - A – Design/Build RFP Examples to be adapted by Owners for projects
        - B – Concrete Durability Data summarized from the tests performed by the IAP agencies from their IAP projects.
        - C – Reinforcing Steel Critical Chloride Content. Tabulation of data from literature for the chloride content to initiate corrosion of reinforcing steel for various grades of corrosion resistant reinforcement.
        - D – Worked Design Examples. Service Life Design examples of bridges in different environmental exposures. (See Task 2.1d.)
        - E – Concrete Material Supplemental Specification. Boiler plate material specification to be adapted by Owners to achieve more durable concrete on projects.
        - F – Example Birth Certificate and Recommendations for Through-Life Management Documentation. Guidance on recording of durability data on projects during design and

construction, and recommendations on maintenance and inspection monitoring during in-service use. (See Task 2.1d.)

- Task 2.1c – Simple SLD Application Tool
  - Developed a Full-Probabilistic Tool in Excel for evaluating the initiation of chloride induced corrosion.
  - Developed supplemental graphical solutions to evaluate concrete durability properties and cover depths for varying environmental exposure conditions. The charts are developed from a full-probabilistic analysis but are much simpler to use.
  - Developed an Excel spreadsheet tool to create chloride profile from cores taken from existing structures. This is used to evaluate chloride surface loading for new structures and estimate remaining service life for existing structures.
- Task 2.1d – Five (5) Worked SLD Design Examples
  - 1 – Durability Assessment of a Bridge Substructure
  - 2 – Steel Girder Bridge in the NE US subjected to heavy de-icing environment
  - 3 – Concrete Bridge in the SE US subjected to a harsh marine environment
  - 4 – Developed load and resistance factor approach to Service Life Design using the results from Examples 2 and 3.
  - 5 – Developed a Birth Certificate for the Oregon DOT Ochoco Creek Bridge.
- Task 2.1e – Life Cycle Cost Analysis Report and Example.
- Task 2.1g – Two Webinars – Content and Training Materials
  - Introduction to Service Life Design Webinar – delivered February 2, 2015
  - Worked Design Example Webinar – 1.5-hour webinar showing example 2 from the Worked SLD Design Examples from Task 2.1d, delivered March 20, 2019
- Task 2.1h – Academic Toolbox. Document for university professors to teach basic information on Service Life Design to students. Includes exercises to be completed.

- Task 2.2 IAP Technical Support
  - Task 2.2a – IAP Training & Support
    - Six (6) Initial Training Workshops – For each workshop, the information developed for the Service Life Design Webinar from February 2, 2015 was presented to the agency IAP team. The agency then presented information about the project alternatives they intended to pursue. With the assistance of the SME team, a project workplan for each agency was developed.
      - Oregon DOT, Salem, OR – March 9, 2015
      - Pennsylvania DOT, Pittsburgh, PA – June 10, 2015 (during IBC Conference)
      - Virginia DOT, Richmond, VA – June 12, 2015
      - FHWA Central Federal Lands, Denver, CO – June 15-16, 2015
      - Iowa DOT, Ames, IA – July 15, 2015

- Maine DOT, Augusta, ME – September 7, 2016

- Five (5) Final Workshops – For each workshop, the SME team delivered a more in-depth introduction to Service Life Design and the agency IAP team leaders presented the work they performed to their staff not previously involved with the work. Local consultants and university professors were also invited.
  - Pennsylvania DOT, Harrisburg, PA – August 16, 2016
  - Virginia DOT, Charlottesville, VA – October 4, 2017
  - Oregon DOT, Portland, OR – January 17, 2018
  - Iowa DOT, Des Moines, IA – September 25, 2018 (completed as part of the MW Peer Exchange)
  - FHWA Central Federal Lands, Honolulu, HI – April 2, 2019 (Workshop was conducted with Hawaii DOT as the bridge designed by CFL will be turned over to HDOT)
  - Maine DOT, Augusta, ME – April 11, 2019

- Task 2.2d – Summary IAP Report (this report)
- Task 2.2e – Participation in Five (5) Regional Peer Exchanges. Twenty-eight (28) states plus FHWA Central Federal Lands attended. There were one-hundred-nine (109) total participants, which included eighty-four (84) external participants. Five (5) representatives of the R19A team attended each event.
  - NW Region, Portland, OR – July 24, 2018. Sixteen (16) total participants from Oregon (5), Washington (2), South Dakota (1), Wyoming (1), Consultants (2), and the SHRP2 team (5). Four (4) states represented.
  - MW Region, Ames, IA – September 25, 2018. Twenty-six (26) total participants from Iowa (15), Michigan (1), Indiana (1), Minnesota (1), Ohio (1), West Virginia (1), academia (1), and the SHRP2 team (5). Six (6) states represented.
  - NE Region, Philadelphia, PA – December 13, 2018. Twenty-one (21) total participants from Pennsylvania (6), Maine (4), Connecticut (1), Delaware (1), Maryland (1), New Jersey (2), Academia (1), Consultants (1), and the SHRP2 team (5). Six (6) states represented.
  - SW Region, Denver, CO – March 12, 2019. Twenty-one (21) total participants from FHWA (8), Colorado (1), Montana (1), Utah (1), Idaho (1), Texas (1), Arizona (1), New Mexico (1), academia (1), and the SHRP2 team (5). Eight (8) states including FHWA represented.
  - SE Region, Richmond, VA – March 27, 2019. Twenty-five (25) total participants from Virginia (16), Florida (1), Tennessee (1), Louisiana (1), Consultants (1), and the SHRP2 team (5). Four (4) states represented.
- Task 2.2f – Participation in up to two (2) Technology Transfer Webinars (project updates)
  - Round 7 Notice and Update on Round 4 Progress – Delivered February 2, 2015
  - Final Project update Webinar – All IAP agencies updated the results of their projects. The SME team discussed tools developed. Delivered February 21, 2019

- Task 2.3 Other Technical Support

- Presentations (Task 2.3b – Participation in up to six (6) National Conferences), seven (7) made by Mike Bartholomew
  - National Association of Corrosion Engineers (NACE), Corrosion 2015 Symposium, Dallas, TX, March 17, 2015 – Presentation to familiarize the corrosion community on the goals of R19A for bridge design.
  - AASHTO Committee on Bridges and Structures (COBS, formerly SCOBS) Annual Meeting, Saratoga Springs, NY, April 21, 2015 – Presentation on a Uniform Service Life Design Guide to the T-9 Technical Committee on Bridge Preservation.
  - AASHTO Committee on Bridges and Structures (COBS, formerly SCOBS) Annual Meeting, Minneapolis, MN, June 28, 2016 – R19A Implementation Update to the T-9 Technical Committee on Bridge Preservation.
  - AASHTO Committee on Bridges and Structures (COBS, formerly SCOBS) Annual Meeting, Spokane, WA, June 13, 2017 – R19A Implementation Update to the T-9 Technical Committee on Bridge Preservation.
  - AASHTO Committee on Bridges and Structures (COBS, formerly SCOBS) Annual Meeting, Burlington, VT, June 25, 2018 – R19A Implementation Update to the T-9 Technical Committee on Bridge Preservation.
  - American Segmental Bridge Institute (ASBI) Annual Convention, Dallas, TX, November 2-3, 2015 – Presentation on Construction Testing and Documentation Requirements for Service Life Design. (Segmental bridges are often large projects requiring a specified Service Life)
  - American Segmental Bridge Institute (ASBI) Annual Convention, Dallas, TX, November 8, 2016 – Presentation on Service Life Design for Alternative Project Delivery.
- Workshops and/or showcases (Two (2) Workshops as part of Task 2.3b for Participation in National Conferences)
  - Service Life Design and Engineering Workshop W05, International Bridge Conference (IBC), June 6, 2016, Washington, DC. Four-hour workshop introducing Service Life Design to the bridge community, including a panel discussion with leaders from Owner Agencies, Trade Organizations, Consulting Engineering Firms, and Contractors. Presenters were Mike Bartholomew/Jacobs and Anne-Marie Langlois/COWI
  - Service Life Design Workshop W-8 – Worked Design Example, International Bridge Conference (IBC), June 14, 2018, Washington, DC. Four-hour workshop to present a Service Life Design example of a steel girder bridge in a heaving de-icing environment. Presenters were Mike Bartholomew/Jacobs and Neil Cumming/COWI
- Task 2.3d – Ad Hoc Technical Assistance to Non-IAP States
  - Developed SLD Design Summary Tech Memo for Washington DOT, October 2, 2018
  - Reviewed and gave recommendations for a SLD proposal using weathering steel piles for West Virginia DOT D/B project April 26, 2109.

- Field Activities
  - Construction or other Implementation activities – Agencies performed (or subcontracted) chloride migration tests on concrete mix designs. They also cored existing structures to develop chloride profiles. These field activities were recommended by the SME team as part of the work plans for

projects. Data has been collected and summarized in the Summary Guide and individual agency reports. Also performed field pull-off tests of overlays.

Outcomes

- State Feedback; Change in Practice

  Oregon

  1 – ODOT will use the newly refined Service Life Design Specification for Alternative Delivery projects developed under Phase 3 of the Oregon Lead Adopter Funding from FHWA, such as Design-Build and CM-GC delivered projects. This spec is considered a leap forward in providing appropriate guidance to contractors and contractor design firms in how to conduct and document service life principles for a major, high cost bridge that is intended to remain in service longer than routine bridges. It incorporates lessons learned from the first three large Design-Build projects in the US designed for a specific service life and one Canadian Public-Private Partnership bridge design effort.

  2 – ODOT plans to continue and expand the effort under Phase 2 of the Oregon Lead Adopter Funding from FHWA to characterize deck deterioration from chloride loading and environmental drivers. ODOT will use this work to identify specific regions in the State that have consistent deterioration patterns and provide service life design guidance tailored to the requirements in each geographic region to achieve service life design goals for routine bridge design. This includes developing a "contour" map of surface chloride loading for coastal, Willamette Valley, Cascades, Central and Eastern climate regions.

  3 – ODOT plans to develop and standardize specific mix designs, cover depths, reinforcement types applicable for each region and incorporate into the Bridge Design and Drafting Manual (BDDM) and standard specifications.

  4 – Based on the overarching impact of concrete cover on bridge deck performance as a principle finding of the study, ODOT will consider adding requirements for measuring concrete cover dimensions on hardened concrete for all new and existing bridges as a requirement in the standard construction specifications and chloride sampling effort.

  5 – ODOT plans to establish requirements for recording as-built documentation of durability properties (mix designs/test results, cover dimensions) during construction, perhaps similar to the proposed fib “Birth Certificate”, as part of an enhanced asset management system.

  6 – New BDDM guidance will also identify new bridge design cases where a stand-alone, bridge specific Service Life Design effort as conducted under Phase 1 of the Oregon Lead Adopter Funding from FHWA is required. Guidance will be provided on how to conduct and document the project-specific design effort.

  7 – ODOT is moving forward in the development of a comprehensive plan for periodic sampling/coring of bridge decks for chloride profiling for condition assessment of a set of “indicator” bridges to be used in selecting preservation actions for similar bridges.

  8 – ODOT is planning to develop guidelines for in-place chloride level limits for decision making on preservation actions such as minor repairs, partial deck removal and overlay, and full deck removal and replacement.

  Pennsylvania

1 – Large variations in the results of the chloride migration tests across the state has led PennDOT to investigate modification of their standard concrete specifications. They are considering setting maximum chloride migration requirements and requiring testing to be performed during construction.

2 – The large fluctuation in results using limestone aggregate has prompted further research into the source of the differences, and could also modify standard specifications.

Virginia

1 – VDOT's Structure and Bridge Division should work with VTRC to assess the NT Build 492 test method in relation to Virginia Test Method 112 and evaluate the reason behind the high variability in chloride migration across different regions in Virginia.

2 – Results of the assessments of the bridges support the use of low-cracking concrete and corrosion-resistant reinforcement to achieve a 100-year service life.

3 – Since VDOT specifications do not require NT Build 492 testing, VDOT's Structure and Bridge Division should work with VTRC to consider evaluating and correlating the performance of concrete mixtures related to the chloride migration as determined by both current specifications (Virginia Test Method 112) and the NT Build 492 test for the current concrete mixture specifications. In addition, the finding of high variability across regions in the consistency of the chloride migration coefficient results suggests that project-specific specifications and quality control / quality assurance procedures may be necessary to achieve the intended service life.

Iowa

1 – Implement a policy on the use of overlays to extend the Service Life of bridge decks in Iowa.

2 – Implement a policy on the use of various types of deck reinforcements to extend the Service Life of bridge decks in Iowa.

3 – The implementation of Service Life Design as outlined in the above bullets will utilize life cycle cost analysis. Type of overlay and reinforcement to be used will be based on factors such as environmental exposure, road classification, age and condition of decks (for existing structures), etc.

FHWA Central Federal Lands

1 – The CFL project was located in the tropical environment of Hawaii, where higher average temperatures and exposure to seawater can result in some of the highest rates of corrosion. The bridges are within 1,000 ft from the ocean and were anticipated to be in brackish water and have a high level of chloride exposure. Testing performed on the existing bridge and water from the stream showed chloride levels to be less than ordinary drinking water. The more relevant exposure conditions for these bridges is to airborne chlorides. This showed the importance of evaluating the site conditions to develop the proper exposure zones.

2 – CFL intends to implement the development of standards for Service Life Design and updating the Federal Lands Highway Bridge Design Manual using the knowledge gained from R19A.

3 – CFL also recognizes the need for documenting and archiving the design and as-built durability parameters (the project "Birth Certificate") and identifying the asset management and inspection role to assist in future evaluation of remaining service life.

Maine

1 – Rebar cover thickness is critical. While this was known, the full-probabilistic modeling really shows it. With current NDT technology like handheld Ground Penetrating Radar (GPR) units, Maine DOT could adopt specifications to ensure minimum cover achieved.

2 – Exposure Zone Definition. Forces designers to think through the potential risks and mitigation strategies.

3 – Chloride profiling existing bridges prior to replacement could provide valuable data for decision making. Makes most sense on coastal structures but can be applied to bridge decks in all regions of the state.

3 – Initiate the use of full probabilistic modeling approach on larger bridge projects (design-build). Would give contractor flexibility on how to achieve acceptable levels.

4 – Develop chloride migration coefficient result database for our concrete mixes. At a minimum investigate performing additional tests from Jonesport-Beals Island Bridge.

5 – If Maine performs more chloride migration coefficient tests, they will look to develop correlation to surface resistivity tests and has noted that Virginia DOT has done some research on this.

- Action/Adoption Plans (who/what/when)

  The IAP successfully introduced processes to investigate Service Life Design of Bridges to six agencies that had various levels of knowledge of the concept. During the R19A project, another similar them project was initiated through NCHRP project 12-108, Guide Specification for Service Life Design of Highway Bridges. A vote on accepting the guide specification is anticipated at the AASHTO Committee on Bridges and Structures in June 2019. Between R19A and NCHRP 12-108, new tools have been developed and introduced that will lead to developing longer lasting bridges. Through the R19A Peer Exchanges, we learned that more widespread use of Service Life Design will likely be tied to requirements directed by either AASHTO or FHWA policies on the topic.

- State Organizational Structure Change; New Role Designations

  One of the group discussion topics at the Peer Exchanges was:

  “What Organizational Structures Are Required to Successfully Achieve Longer Lasting Bridges?”

  One of the main issues that the SME team discussed with all the agencies is that achieving a longer Service Life involves making changes in all phases in the life of a bridge – Design, Construction, and In-Service Operations (Inspection, Maintenance, and Rehabilitation), with no one phase being more important than the others. A common theme from all five Peer Exchanges was that communication between Design, Construction and Operations often was not being performed adequately. Once the Design Section has completed a bridge, the Construction Division takes over and has very little interaction with the designers. With implementation of a new process like Service Life Design, there are new design processes and new durability testing processes required during construction that are currently unfamiliar to construction staff. Extra communication is required between the two groups to ensure that the design intent is met during the construction phase. Achieving a longer life for a bridge will often require new inspection, maintenance, and durability monitoring activities to be performed that may be unfamiliar to the Operations Division. Again, extra communication is required between design and operations to

educate staff on the importance of performing these new activities. One recommendation from the Peer Exchanges was to establish a new role within the organization to make sure that communication between groups is happening.

- Based on the discussion above on State Organizational Structure Change, it may be valuable to establish a future research project to investigate how to improve communications between the separate Design, Construction, and Operations Divisions of state agencies, particularly for the implementation of the Service Life Design concept.

  In the final agency workshops for CFL and Maine, both made recommendations to coordinate with the AASHTO Materials and Pavements committee to investigate adopting the procedures of the Nordtest NT Build 492 test into the AASHTO TP-64 Standard Method of Test for Predicting Chloride Penetration of Hydraulic Cement Concrete by the Rapid Migration Procedure (i.e., chloride migration coefficient). It is believed that it would be much easier for agencies to implement tests that have been recommended and certified by a US based organization.

Benefits

- Progress Towards Implementation Goals

  Goal 1 – Building national awareness of Service Life Design through marketing, training, and formal IAP targeting use and integration within 15% of state transportation agencies.

  Implementation –

  Five (5) IAP states plus FHWA Central Federal Lands participation with actual Service Life Design projects amounted to 10% participation. However, a broad marketing and training effort was achieved via four (4) national webinars, seven (7) national conference presentations, one (1) half-day workshop including an industry panel discussion, one (1) half-day training workshop of a worked reference example, and five (5) Peer Exchanges where an additional twenty-three (23) states participated.

  Goal 2 – Develop a Service Life Design Summary Guide.

  Implementation –

  The SME team using the results gathered from the IAP agency projects developed the Summary Guide. One project objective was to condense the 700+ page document, “Design Guide for Bridges for Service Life”, produced during the TRB portion of the program into a smaller step-by-step guide to performing a Service Life Design. The Summary Guide is a 50-page document supplemented by six appendices of useful data, Service Life Design reference examples and sample specifications.

  Goal 3 – Deliver pressing technology needs during implementation assistance.

  Implementation –

  The SME team developed Service Life Design tools for evaluating chloride profiles on existing structures and performing full-probabilistic modeling of chloride ingress tool to assist in the selection of concrete mix designs and cover depth. Agencies were guided in the use of new durability testing procedures for determination of chloride migration properties (NT Build 492).

Five (5) worked reference examples were developed to show the Service Life Design process – three (3) containing actual design calculations, one (1) showing the documentation of design and as-built conditions (the "Birth Certificate"), and one (1) demonstrating how a load and resistance factor methodology could be developed to simplify the Service Life Design process is in the future.

The team created an Academic Toolbox, complete with problem exercises, that can be used by university professors to teach the basics of Service Life Design to students.

Additionally, a Life Cycle Cost Analysis report was developed to promote the concept of integrating the principles of Life Cycle Cost Analysis with Service Life Design of bridges to demonstrate the importance of considering both the initial cost and cost of ownership. The document includes a worked LCC example for maintenance of a bridge and an example wherein LCCA is used to evaluate two potential design features of a bridge.

- Quotes, Letters of Support, Other Activities

  Comments from the NW Peer Exchange in Portland, OR.

  Bruce Johnson/ODOT – "In terms of doing it (Service Life Design) in Oregon, if we didn't have seed money to do testing and especially if we didn't have access to subject matter experts, we would not have accomplished what we did."

  Paul Strauser/ODOT – "If doing the service life design by myself, it would have been tough. The tools supplied were excellent. The SME team knowledge on testing side was a big piece to making this work."

- Quantification of Gain (money, time, safety, or improved quality)

  Money – Oregon DOT's work on bridge deck rehabilitation using chloride profiling has spent somewhere on the order of $300k on performing testing but has saved between $2M and $3M in eliminating unnecessary overlay work. Oregon is confident that they are doing the right thing.

  Improved Quality – The implementation of service life design by VDOT has the potential to increase, or guarantee, the longevity of bridge decks in Virginia. Bridge decks that meet their design targets reduce both life-cycle costs and disruptions to motorists. Although modern materials used by VDOT (including low-cracking concrete and corrosion-resistant steel) have been assumed to offer service in excess of 100 years, a fully probabilistic, quantitative approach such as that described in this study can ensure this level of performance.

Website links

The AASHTO SHRP2 R19A web page contains the tools and deliverable documents produced by the SME team, final reports from the participating agencies, and the presentations made for webinars and Peer Exchanges. The link is:

http://shrp2.transportation.org/Pages/ServiceLifeDesignforBridges.aspx

Appendix A. – List of Key Agency Participants

Technical Points of Contact and Team Members
FHWA Central Federal Lands Highway Division POC – Bonnie Klamerus, Supervisory Structural Team Leader Mike Voth, Pavement & Materials Team Leader Guar Johnson, Civil & Environmental Engineering, University of Hawaii (now with Moffatt & Nichol)
Iowa DOT POC – Ahmad Abu-Hawash, Chief Structural Engineer Norm McDonald, State Bridge Engineer (now retired) Jim Nelson, State Bridge Engineer Kevin Jones, Materials Testing Engineer Dean Bierwagen, Final Design Section Leader Lily Yang Ping Lu Brent Phares, Research Associate Professor, CCEE, Iowa State University Katelyn Freeseman, Assistant Director of Bridge Engineering Center, CCEE, Iowa State University
Maine DOT POC – Dale Peabody, Director, Transportation Research Wayne Frankhauser, Bridge Program Manager Robert Blunt, Project Manager, VHB
Oregon DOT POC – Bruce Johnson, State Bridge Engineer Craig Shike, Bridge Operations & Standards Managing Engineer Ray Bottenberg, Bridge Preservation Managing Engineer Andrew Blower, Bridge Preservation Corrosion Engineer Paul Strauser, Structural Design Engineer
Pennsylvania DOT POC – Tom Macioce, Chief Bridge Engineer Clay Naito, Professor, Department of Civil and Environmental Engineering, Lehigh University
Virginia DOT POC – Prasad Nallapaneni, Assistant State Structure & Bridge Engineer Kyle Haber, Bridge Engineer Mike Brown, Associate Director of Research, VTRC (now with WSP) Soundar Balakumaran, Research Scientist, VTRC Harikrishnan Nair, Senior Research Scientist, VTRC Madeleine Flint, Assistant Professor, Civil and Environmental Engineering, Virginia Tech University Elizabeth Bales, Student, Virginia Tech University

Appendix B. – Webinar Agenda

SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Durability Design & Structure Birth Certificate
SHRP2 Service Life Design for Bridges (R19-A)

Implementation Plan Webinar

February 2, 2015

Mike Bartholomew, PE

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

Agenda

- Introduction
- Service Life Design Principles
- Durability Assessment Guides/Tools
- Service Life Design Strategies
- Through Life Management
- Structure Birth (or Durability) Certificate
- Existing Structures
- Summary Review

SHRP2 SOLUTIONS
TOOLS FOR THE ROAD AHEAD

Second Strategic Highway Research Program (SHRP2)

Round 7 Implementation Assistance Program Webinar

Structure Solutions

(R06A, R06G, R19A, R19B)

March 9, 2016

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO
The Voice of Transportation

Agenda

- SHRP2 update
- Implementation Assistance Program opportunities
- Product description & assistance opportunities:
  - *Nondestructive Testing for Concrete Bridge Decks* (R06A)
  - *Nondestructive Testing for Tunnel Linings* (R06G)
  - *Service Life Design for Bridges* (R19A)
  - *Service Limit State Design for Bridges* (R19B)
- Round 7 Schedule
- Questions

Introduction | R06A | R06G | R19A | R19B | Closing/Q&A

SHRP2 SOLUTIONS | 2

SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

Overview – SHRP2 R19A: Service Life Design of Bridges

Webinar

Mike Bartholomew, P.E.
Subject Matter Expert (SME) Team Leader
Senior Principal Bridge Engineer
Jacobs Engineering

February 21, 2019

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Agenda

- **Introduction –** Mike Bartholomew
- **Brief overview of project R19A** – Raj Ailaney
- **Reports on IAP States individual projects with lessons learned**
  - OR – Bruce Johnson
  - PA – Tom Macioce
  - VA – Prasad Nallapaneni
  - ME – Dale Peabody
  - CFL –Mike Voth
  - IA - Dean Bierwagen and Katelyn Freeseman
- **Tools/resources developed for use in service life design** – Mike Bartholomew
- **Update on NCHRP 12-108, Guide Specification for Service Life Design of Highway Bridges** – Bruce Johnson
- **Questions**

2

SHRP2 SOLUTIONS
STRATEGIC HIGHWAY RESEARCH PROGRAM

SHRP2 Service Life Design of Bridges (R19A) Webinar

Walk-through Durability Design Example

Mike Bartholomew, P.E.
Jacobs

Raj Ailaney, P.E.
FHWA

Brad J. Pease, Ph.D.
COWI North America Ltd.

March 20, 2019

U.S. Department of Transportation
Federal Highway Administration

American Association of State Highway and Transportation Officials
AASHTO

Agenda

- Brief overview of the Service Life Design for Bridges
  - Introduction to R19A project
  - Available tools/resources
- Principles of Service Life Design
  - Design to resist deterioration from environment
  - Avoidance of deterioration
- Durability Design Example - Steel girder bridge with de-icing exposure
  - Part 1: Project details, exposure conditions, etc.
  - Part 2: Service life design of reinforced concrete elements
  - Part 3: Service life design of steel elements
  - Part 4: Implementing service life design during construction

2

Appendix C. Peer Exchange Agenda and Participants List

SHRP2 R19A Service Life Design for Bridges
Oregon Peer Exchange, July 24, 2018

DoubleTree by Hilton - Portland
1000 NE Multnomah Street, Portland OR 97232

Time	Topic	Speakers
8:30 – 8:50 am	**Welcome and SHRP2 Introduction** • FHWA, AASHTO, & State Introduction (20 min)	Raj Alainey, FHWA Pam Hutton, AASHTO Bruce Johnson, ODOT
8:50-10:15	• Service Life Design Concepts • Introduction to Service Life Design (SLD) (30 min) • Implementing Service Life Design for Concrete Structures (30 min) • Group Discussion Topic – What does 100-yr SLD mean? (20 min)	Mike Bartholomew, CH2M Anne-Marie Langlois, COWI All participants
10:15-10:30 am	**Break**	
10:30-12:00 am	**R19A Implementation Updates** • Goals of Oregon's R19A Participation (10 min) • Design of Ochoco Creek Bridge (25 min) • Bridge Deck Deterioration & Rehabilitation (30 min) • Group Discussion Topic – Challenges of Durability Testing (25 min)	Bruce Johnson, ODOT Paul Strauser, ODOT Andrew Blower, ODOT All participants
12:00-1:00 pm	**Lunch**	
1:00-2:20pm	**R19A Implementation Updates (continued)** • RFP for Service Life Design for Design-Build (D/B) Projects (20 min) • Group Discussion Topic – Challenges of D/B projects (20 min) • R19A Participation from Other Agencies (20 min) • NCHRP 12-108 Guide Specification for Service Life Design (20 min)	Craig Shike, ODOT All participants Mike Bartholomew, CH2M Bruce Johnson, ODOT
2:20-2:40 pm	**Break**	
2:40-4:30 pm	**Group Discussion Topics (To be updated based on survey responses)** • Design Issues – How is concrete cracking taken into account? • Construction – How can we verify the durability properties specified in design are achieved during construction? • In-Service – How can a regular monitoring plan be implemented to verify that performance matches design intent? • What Organizational Structures Are Required to Successfully Achieve Longer Lasting Bridges?	Bruce Johnson, ODOT - Facilitator All participants
4:30-5:00 pm	**Wrap Up & Adjourn** • Additional Topics to Consider for Future Peer Exchanges • Fill Out Evaluation Forms	Mike Bartholomew, CH2M

SHRP2 R19A Service Life Design for Bridges
Oregon Peer Exchange, July 24, 2018
SIGN IN SHEET

Initial	Name	Agency
AB	Andrew Blower	OR
BJ	Bruce Johnson	OR
CS	Craig Shike	OR
X	Fatemeh Alapour	COWI
JZB	Joan Zhong-Brisbois	WSP USA
LT	Luong Tran	WA
MRM	Melissa Moncada	Jacobs
MB ✓	Mike Bartholomew	Jacobs
✓	Neil Cumming	COWI
NR	Nicholas Rodda	WA
PH	Pam Hutton	AASHTO
PS	Paul Strauser	OR
RAJ	Raj Ailaney	FHWA
RR	Randy Ringstmeyer	WY
RB	Ray Bottenberg	OR
SK	Steven Kerr	SD
EK	Eric Kus	TY. Lin International

SHRP2 R19A Service Life Design for Bridges
Midwest Region Peer Exchange

Tuesday, September 25, 2018
Embassy Suites by Hilton
101 E. Locust St., Des Moines, Iowa 50309

Time	Topic	Speakers
8:30 – 9:05 am	**Welcome and SHRP2 Introduction** • FHWA, AASHTO, & State Introduction (25 min) • Goals of Iowa's R19A Participation (15 min)	Pam Hutton, AASHTO Raj Ailaney, FHWA Jim Nelson, Iowa DOT Ahmad Abu-Hawash, Iowa DOT
9:10-10:30	**Service Life Design Concepts** • Introduction to Service Life Design (SLD) (30 min) • Implementing Service Life Design for Concrete Structures (30 min) • Group Discussion Topic – What does 100-yr SLD mean? (20 min)	Mike Bartholomew, Jacobs Brad Pease, COWI All participants
10:30-10:45 am	**Break**	
10:45-12:00 am	**R19A Implementation Updates** • Overview of Material Testing for Service Life Design (25 min) • Chloride Surface Loading on Iowa Bridge Decks (25 min) • Group Discussion Topic – Challenges of Durability Testing (25 min)	Brad Pease, COWI Mike Bartholomew, Jacobs All participants
12:00-1:00 pm	**Lunch**	
1:00-2:40pm	**R19A Implementation Updates (continued)** • ASTM A1010 High Chromium Structural Steel Bridge (20 min) • South Skunk River Bridge – Service Life Comparison (25 min) • Thin Polymer Overlays (25 min) • Group Discussion Topic – Avoidance of Deterioration vs. Design Based on the Environment (30 min)	Brent Phares, Iowa State U. Lily Yang, Iowa DOT Ping Lu, Iowa DOT All participants
2:40-3:00 pm	**Break**	
3:00-4:30 pm	**Group Discussion Topics** • Design Issues – How is concrete cracking taken into account? • Construction – How can we verify the durability properties specified in design are achieved during construction? • In-Service – How can a regular monitoring plan be implemented to verify that performance matches design intent? • What Organizational Structures Are Required to Successfully Achieve Longer Lasting Bridges?	Mike Bartholomew, Jacobs – Facilitator All participants
4:30-5:00 pm	**Wrap Up & Adjourn** • Additional Topics to Consider for Future Peer Exchanges • Fill Out Evaluation Forms	Mike Bartholomew, Jacobs

SHRP2 R19A Service Life Design for Bridges One Day Workshop, Sept 25, 2018
Iowa Department of Transportation

	First Name	Last Name	Organization/Agency	Email
			STATE DOT'S With Invitational Travel	
	Steve	Kahl	Michigan DOT	Kahls@michigan.gov
	Greg	Sanders	Missouri DOT	gregory.sanders@modot.mo.gov
	Reza	Zandi	Ohio DOT	Reza.Zandi@dot.ohio.gov
	Robert	Poldervaart	Indiana DOT	rpoldervaart@indot.in.gov
	Billy	Varney	West Virginia DOT	william.h.varney@wv.gov
	Sarah	Sondag	Minnesota DOT	sarah.sondag@state.mn.us
		State DOT'S Without Invitational Travel		
	Ahmad	Abu-Hawash	Iowa DOT	ahmad.abu-hawash@iowadot.us
	James	Nelson	Iowa DOT Director	James.s.nelson@iowadot.us
	Mateusz	Rolkowski	Iowa DOT	mateusz.rolkowski@iowadot.us

SHRP2 R19A Service Life Design for Bridges One Day Workshop, Sept 25, 2018
Iowa Department of Transportation

	First Name	Last Name	Organization/Agency	Email
	David	Evans	Iowa DOT	david.evans@iowadot.us
HA	Harold	Adcock	Iowa DOT	harold.adcock@iowadot.us
ZA	Zahrah	Alghalibi	Iowa DOT	Zahrah.Alghalibi@iowadot.us
	Scott	Neubauer	Iowa DOT	scott.neubauer@iowadot.us
	Jim	Hauber	Iowa DOT	james.hauber@iowadot.us
	David	Bare	Iowa DOT	david.bare@iowadot.us
	Mike	Todsen	Iowa DOT	michael.todsen@iowadot.us
	Ping	Lu	Iowa DOT	ping.lu@iowadot.us
	Lili	Yang	Iowa DOT	lili.yang@iowadot.us
	Logan	Wells	Iowa DOT	logan.wells@iowadot.us

SHRP2 R19A Service Life Design for Bridges One Day Workshop, Sept 25, 2018
Iowa Department of Transportation

	First Name	Last Name	Organization/Agency	Email
	Haiping	Chen	Iowa DOT	haiping.chen@iowadot.us
	Brent	Phares	Iowa State University	bphares@iastate.edu
	Jesse	Peterson	Iowa DOT	jesse.peterson@iowadot.us
	KATELYN	FREESEMAN	IOWA STATE UNIVERSITY	Kfreese@iastate.edu
	GARY	NOVEY	IowaDOT	gary.novey@iowadot.us
			FHWA/AASHTO	
	Pam	Hutton	AASHTO	phutton@aashto.org
	Patricia	Bush	AASHTO	pbush@aashto.org
	Raj	Ailaney	FHWA- RC	Raj.Ailaney@dot.gov
			PRIVATE SECTOR	

SHRP2 R19A Service Life Design for Bridges One Day Workshop, Sept 25, 2018
Iowa Department of Transportation

	First Name	Last Name	Organization/Agency	Email
	Mike	Bartholomew	Jacobs	Mike.Bartholomew@jacobs.com
pm	Brad	Pease	COWI	brpe@cowi.com
	Chad	Meyer	Jacobs	chad.meyer@jacobs.com

SHRP2 R19A Service Life Design for Bridges
Northeast Region Peer Exchange, December 13, 2018

Double Tree by Hilton Philadelphia Center City

Time	Topic	Speakers
8:30 – 8:50 am	**Welcome and SHRP2 Introduction** • AASHTO, FHWA & State Introduction (20 min)	Patricia Bush, AASHTO Raj Ailaney, FHWA Wayne Frankhauser, Maine DOT
8:50-10:15 am	**Service Life Design Concepts** • Introduction to Service Life Design (SLD) (30 min) • Implementing Service Life Design for Concrete Structures (30 min) • Group Discussion Topic – What does 100-yr SLD mean? (20 min)	Mike Bartholomew, Jacobs Neil Cumming, COWI All participants
10:15-10:30 am	**Break**	
10:30-12:00 am	**R19A Implementation Updates** • Goals of Maine's R19A Participation (10 min) • Goals of Pennsylvania's R19A Participation (10 min) • Overview of Material Testing for Service Life Design (25 min) • Pennsylvania's Concrete Durability Testing Program (25 min) • Group Discussion Topic – Challenges of Durability Testing (20 min)	Wayne Frankhauser, Maine DOT Tom Macioce, PennDOT Neil cumming, COWI Clay Naito, Lehigh University All participants
12:00-1:00 pm	**Lunch**	
1:00-2:30pm	**R19A Implementation Updates (continued)** • Maine's Forever Bridge – Beal's Island (45 min) • R19A Participation from Other Agencies (20 min) • Group Discussion Topic – Avoidance of Deterioration vs. Design Based on the Environment (25 min)	Bob Blunt, VHB Mike Bartholomew, Jacobs All participants
2:30-2:50 pm	**Break**	
2:50-4:30 pm	**Group Discussion Topics** • Design Issues – How is concrete cracking taken into account? • Construction – How can we verify the durability properties specified in design are achieved during construction? • In-Service – How can a regular monitoring plan be implemented to verify that performance matches design intent? • What Organizational Structures Are Required to Successfully Achieve Longer Lasting Bridges?	Mike Bartholomew, Jacobs - Facilitator All participants
4:30-5:00 pm	**Wrap Up & Adjourn** • Additional Topics to Consider for Future Peer Exchanges • Fill Out Evaluation Forms	Mike Bartholomew, Jacobs

R19A North East Peer Exchange
Philadelphia, PA
December 13, 2019

	First	Last	Agency	Email
✓	Raj	Ailaney	FHWA	raj.ailaney@dot.gov
✓	Gerard	Babinski	Pennsylvania DOT	gbabinski@pa.gov
✓	Mike	Bartholomew	Jacobs	Mike.Bartholomew@jacobs.com
✓	Priti	Bhardwaj	Connecticut DOT	priti.bhardwaj@ct.gov
✓	Bob	Blunt	Vermont Agency of Transportation	rblunt@vhb.com
✓	Patricia	Bush	AASHTO	pbush@aashto.org
✓	Hannah Xia	Cheng	New Jersey DOT	Xiaohua.Cheng@dot.nj.gov
✓	Tyler	Culhane	Pennsylvania DOT	tculhane@pa.gov
✓	Neil	Cumming	COWI	ncgx@cowi.com
✓	Lamont	Dutra	Maine DOT	Lamont.dutra@outlook.com
✓	Wayne	Frankhauser	Maine DOT	Wayne.Frankhauser.Jr@maine.gov
✓	Eddy	Germain	New Jersey DOT	eddy.germain@dot.nj.gov
✓	Scott	Haradon	Maine DOT	Robert.haradon@maine.gov
✓	Jason	Hastings	Delaware DOT	Jason.Hastings@state.de.us
✓	Nikki	Krise	Pennsylvania DOT	NKRISE@pa.gov
	James	Lacroix	Vermont Agency of Transportation	james.lacroix@vermont.gov
✓	Tom	Macioce	Pennsylvania DOT	tmacioce@pa.gov
✓	Dipa	Patel	Maryland DOT - SHA	dpatel2@sha.state.md.us
✓	Louis	Ruzzi	Pennsylvania DOT	lruzzi@pa.gov
✓	Joseph	Stilwell	Maine DOT	Joseph.r.stilwell@maine.gov
✓	Serge	Ter-Arakelov	Pennsylvania DOT	STERARAKEL@pa.gov

SHRP2 R19A Service Life Design for Bridges
Southwest Region Peer Exchange

March 12, 2019 – Denver, CO
Hampton Inn & Suites Denver-Downtown
1845 Sherman Street, Denver, Colorado 80203

Time	Topic	Speakers
8:30 – 8:50 am	**Welcome and SHRP2 Introduction** • FHWA, AASHTO, & Agency Introduction (20 min)	Raj Ailaney, FHWA Patricia Bush, AASHTO Bonnie Klamerus, FHWA CFL
8:50-10:15	**Service Life Design Concepts** • Introduction to Service Life Design (SLD) (30 min) • Implementing Service Life Design for Concrete Structures (35 min) • Group Discussion Topic – What does 100-yr SLD mean? (20 min)	Mike Bartholomew, Jacobs Neil Cumming, COWI All participants
10:15-10:30 am	**Break**	
10:30-12:00 am	**R19A Implementation Updates** • Goals of Central Federal Land's R19A Participation (10 min) • Overview of Material Testing for Service Life Design (25 min) • University of Hawaii Testing Program (30 min) • Group Discussion Topic – Challenges of Durability Testing (25 min)	Mike Voth, FHWA CFL Neil Cumming, COWI Gaur Johnson, U. of Hawaii All participants
12:00-1:00 pm	**Lunch**	
1:00-2:20pm	**R19A Implementation Updates (continued)** • Coastal Bridge Replacements on Kauai North Shore (30 min) • Service Life Comparison using *fib* 34, Life365, and Stadium (30 min) • R19A Participation from Other Agencies (20 min) • Group Discussion Topic – (20 min)	Bonnie Klamerus, FHWA CFL Gaur Johnson, U. of Hawaii Mke Bartholomew, Jacobs All participants
2:20-2:40 pm	**Break**	
2:40-4:30 pm	**Group Discussion Topics** • Design Issues – How is concrete cracking taken into account? • Construction – How can we verify the durability properties specified in design are achieved during construction? • In-Service – How can a regular monitoring plan be implemented to verify that performance matches design intent? • What organizational structures are required to successfully achieve longer lasting bridges?	Mike Bartholomew, Jacobs – Facilitator All participants
4:30-5:00 pm	**Wrap Up & Adjourn** • Future Service Life Design Research Needs • Complete Evaluation Forms	

SHRP2 R19A Service Life Design for Bridges
Southwest Region Peer Exchange
March 12, 2019 – Denver, CO
Hampton Inn & Suites Denver-Downtown
1845 Sherman Street, Denver, Colorado 80203

	First Name	Last Name	Job Title	Agency	Email Address	Sign In
X	Raj	Ailaney	Sr. Bridge Engineer	FHWA	raj.ailaney@dot.gov	
X	Mike	Bartholomew	Senior Principal Bridge Engineer	Jacobs	mike.bartholomew@jacobs.com	
	Steve	Belcher	ADA	FHWA-CFL	steven.belcher@dot.gov	
X	Stephanie	Brandenberger	Bridge Engineer	Montana Dept of Transportation	stbrandenberger@mt.gov	
X	Troy	Branigan	Structural Engineer	Jacobs	troy.branigan@jacobs.com	
X	James	Corney	Structures Project Engineer -	Utah Department of Transportation	JCorney@utah.gov	
X	Neil	Cumming	Consultant/Presenter	COWI	ncgx@cowi.com	
X	Karl	Eikermann	Bridge Design Team Leader	DOT/FHWA/CFLHD	karl.eikermann@dot.gov	
X	Jamal	Elkaissi	Structural Engineer	FHWA/ Resource Center	jamal.elkaissi@dot.gov	
X	Danielle	Germani	Structural Engineer	FHWA - CFL	danielle.germani@dot.gov	
X	Matthew	Greer	Bridge Engineer	FHWA CO Div	matt.greer@dot.gov	
X	Michael	Hyzak	Bridge Engineer	TxDOT Bridge Division	michael.hyzak@txdot.gov	
X	Rick	Jensen	EM-1, Bridge Design	Idaho Transportation Department	rick.jensen@itd.idaho.gov	
X	Bonnie	Klamerus	Supervisory Structural Engineer	CFLHD/FHWA	bonnie.klamerus@dot.gov	
X	Shane	Kuhlman	State Bridge Engineer	NMDOT	shane.kuhlman@state.nm.us	
X	Nathan	Marshall	Civil Engineer (Structural)	FHWA - CFL	nathan.marshall@dot.gov	
X	Ryan	Owen	Bridge Engineer	FHWA - CFLHD	ryan.owen@dot.gov	
	John	Rohner	Sr. Bridge Engineer	Jacobs	john.rohner@jacobs.com	
	SAMIR	SIDHOM	BRIDGE DESIGN TEAM LEADER	FHWA- FLHD	samir.sidhom@dot.gov	
X	Pe-Shen	Yang	Assistant State Bridge Engineer	Arizona Department of Transportation	pyang@azdot.gov	
X	Mike	Voth	Materials Part Engineer	FHWA-CFLHD	michael.voth@dot.gov	
X	Man	Yip	Bridge Engineer	CDOT	Man.yip@state.co.us	
X	Gaur	Johnson	Str Engr	UH	gaur@hawaii.edu	
X	JAMAL	ELKAISSI	SR.ENGR	FHWA	jamal.Elkaissi@dot.gov	
X	Pam	Hutton		AASHTO		

SHRP2 R19A Service Life Design for Bridges
Southeast Region Peer Exchange

March 27, 2019 – Richmond, VA
Embassy Suites Richmond, 2925 Emerywood Parkway

Time	Topic	Speakers
8:30 – 8:50 am	**Welcome and SHRP2 Introduction** • FHWA, AASHTO, & State Introduction (20 min)	Raj Alainey, FHWA Patricia Bush, AASHTO Prasad Nallapaneni, VDOT
8:50-10:15	**Service Life Design Concepts** • Introduction to Service Life Design (SLD) (30 min) • Implementing Service Life Design for Concrete Structures (30 min) • Group Discussion Topic – What does 100-yr SLD mean? (20 min)	Mike Bartholomew, Jacobs Brad Pease, COWI All participants
10:15-10:30 am	**Break**	
10:30-12:00 am	**R19A Implementation Updates** • Goals of Virginia's R19A Participation (10 min) • Overview of Material Testing for Service Life Design (25 min) • Chloride Penetration Resistance and Link to Service Life Design of Virginia Bridge Decks (30 min) • Group Discussion Topic – Challenges of Durability Testing (25 min)	Prasad Nallapaneni, VDOT Brad Pease, COWI Madeleine Flint, Virginia Tech All participants
12:00-1:00 pm	**Lunch**	
1:00-2:20pm	**R19A Implementation Updates (continued)** • Service Life of Bridge Decks – Influence of Cracks (20 min) • VDOT Materials – Low Crack Concrete (20 min) • VDOT Specification for Corrosion Resistant Reinforcement (20 min) • Group Discussion Topic – Avoidance of Deterioration vs. Design Based on the Environment (20 min)	Soundar Balakumaran, VRC Harikrishnan Nair, VRC Prasad Nallapaneni, VDOT All participants
2:20-2:40 pm	**Break**	
2:40-4:30 pm	**Group Discussion Topics** • Design Issues – How is concrete cracking taken into account? • Construction – How can we verify the durability properties specified in design are achieved during construction? • In-Service – How can a regular monitoring plan be implemented to verify that performance matches design intent? • What Organizational Structures Are Required to Successfully Achieve Longer Lasting Bridges?	Mike Bartholomew, Jacobs – Facilitator All participants
4:30-5:00 pm	**Wrap Up & Adjourn** • Fill Out Evaluation Forms	Mike Bartholomew, Jacobs

SHRP2 R19A

MAR 27, 2019

Keith Williams	VDOT - Materials
Ron Simmons	FDOT - SMO
Alan Johnson	VDOT - Richmond S&B
Rajendra Dhakal	VDOT - CO
Kinda Katrib	VDOT - CO
Hamid Ghazizahedi	VDOT - CO S&B
RAJU IYER	VDOT CO S&B
Cody Miear	VDOT Richmond Dist. S&B
JOHN WRIGHT	VDOT RICHMOND DIST. S&B
JIM SWISHER	VDOT MATERIALS - ELKO
Joseph DeJesus	Jacobs Engineering
John Gzal	Jacobs
Houston Walker	Tenn. DOT - Structures
John Schuler	VDOT Material
Thomas E Darby	VDOT Materials
Ehsan Abdullah	VDOT structure & Bridge
Kelly Kemp	LA DOTD Bridge Design
Junyi Meng	VDOT CO. S&B
Harikrishnan Nair	VTRC/VDOT
Soundar Balakumaran	VTRC / VDOT
Prasad Nallapaneni	VDOT S&B.
Ray Mulaney	FHWA HQ.
BEN PAGES	COWI A/S
Mike Bartholomew	Jacobs