



# Overview of SHRP2 R19A and Activities Done by Other States

Virginia DOT Workshop – Charlottesville, VA

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CH2M

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U.S. Department of Transportation  
Federal Highway Administration

AMERICAN ASSOCIATION  
OF STATE HIGHWAY AND  
TRANSPORTATION OFFICIALS

AASHTO

# Presentation Overview



- Need for Service Life Design
- SHRP2 R19A Implementation Action Program
  - Program Goals
  - Work Focus Areas
  - Participating Agency (Lead Adopter) Projects
  - Lessons Learned
- Summary

# Need for Service Life Design



- Growing interest by the industry to make bridges more durable with longer expected lives
- Influenced by political motivation – popular to state that a new bridge will last 100+ years...
- Evident by requirements in recent Owner's RFPs – particularly on Design Build projects

# Service Life Designed Structures

- Ohio River Bridge, KY – 2016 (100 years)





# Service Life Designed Structures

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



# Need More Focus on These

- Representing the majority of the 600,000+ bridges in the US



# Need for Service Life Design



- Expectations of SLD requirements often unclear
- A more robust definition was needed for SLD
- FHWA in conjunction with AASHTO and TRB through the 2<sup>nd</sup> Strategic Highway Research Program (SHRP2) initiated project R19A
  - Bridges for Service Life Beyond 100 Years: Innovative Systems, Subsystems and Components

# SHRP2 Project R19A





# SHRP2 R19A Team

RESEARCH –  
**TRB**

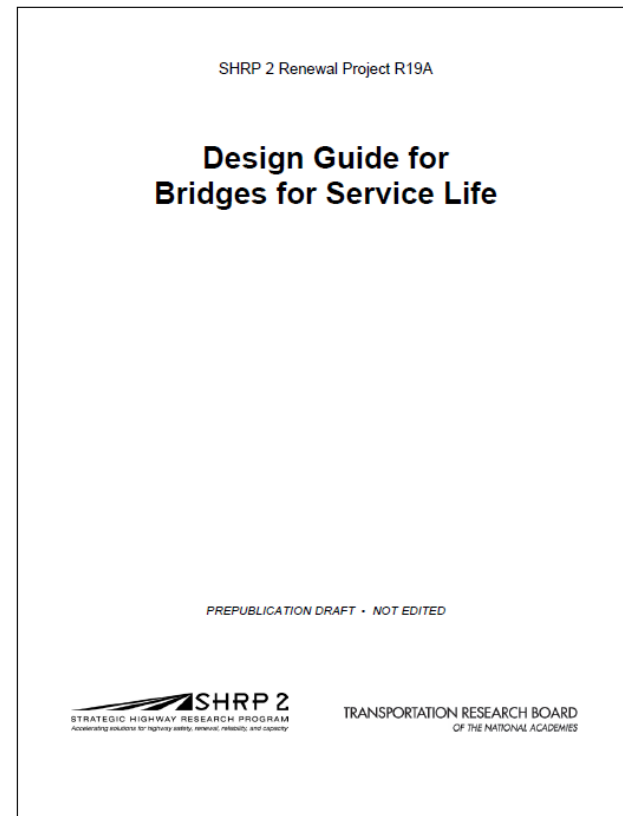
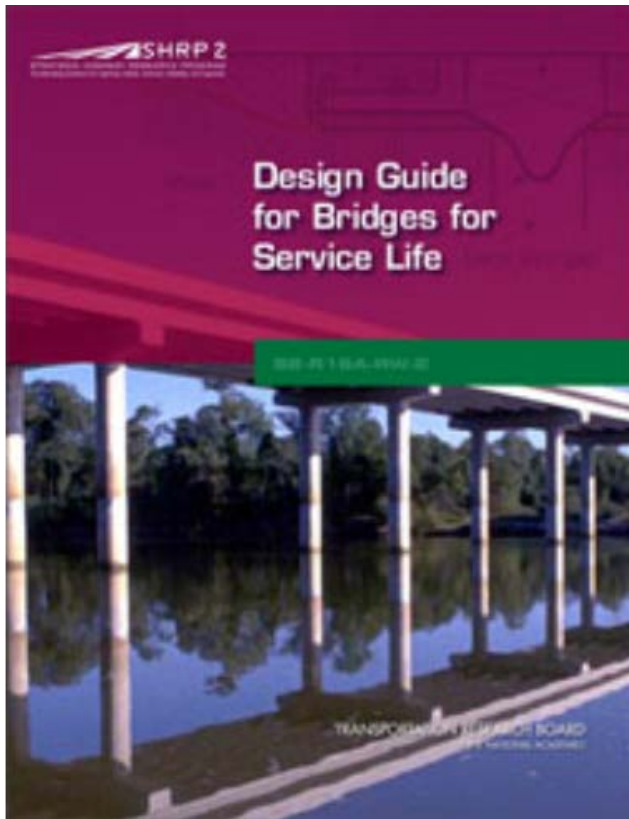
IMPLEMENTATION –  
**FHWA/AASHTO**

SUBJECT MATTER EXPERTS /  
LOGISTICS SME LEAD – **CH2M**  
TECHNICAL SMEs –  
**COWI**

LEAD ADOPTER  
AGENCIES

# Research Work Completed

- Project R19A – Service Life Design Guide



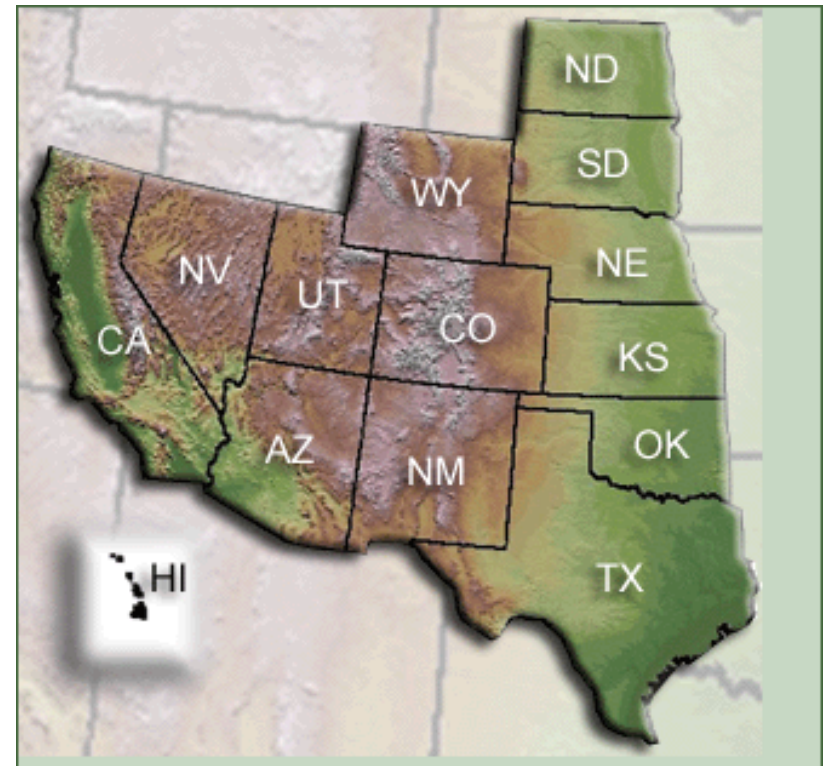
- <http://www.trb.org/Main/Blurbs/168760.aspx>

# IAP Lead Adopter Agencies



**Oregon**

## Central Federal Lands (project in Hawaii)



# IAP Lead Adopter Agencies

Iowa



Maine



Pennsylvania



Virginia

# IAP Goals



- Promote SLD concepts through:
  - Marketing, outreach & training
  - Workshops & Peer Exchanges
- Assist Lead Adopter agencies in developing in-house SLD skills
- Build a strong technical foundation
  - Develop training & reference materials
  - Develop “Academic Toolbox”
  - Lessons learned summaries



# Current Work Focus Areas

- Performing tests on material durability properties of concrete mix designs
  - Concrete chloride diffusion coefficients (NT Build 492)
  - Measurement of as-constructed concrete cover



Elcometer

# Current Work Focus Areas

- Tests on existing bridges to assess environmental loading and material behavior
  - Taking concrete cores to measure chloride loading from de-icing chemicals or sea water

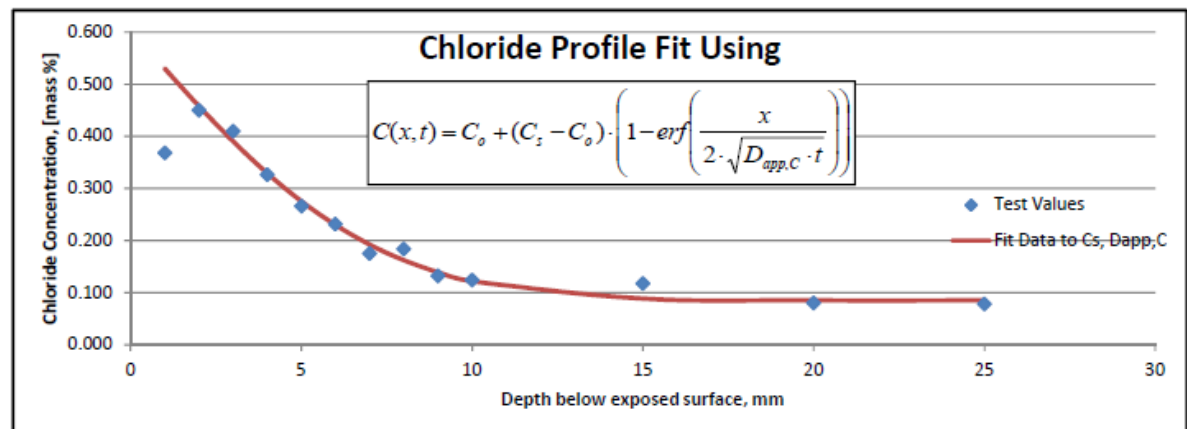


Source: Germann Instruments

# Current Work Focus Areas

- Developing design tools and processes to aid in SLD
  - Excel spreadsheet for chloride profiling




d	depth from surface	[mm]	1	2	3	4	5	6	7	8	9	10	15	20	25	
$C_m$	Test Values	[mass %]	0.368	0.450	0.410	0.326	0.266	0.231	0.175	0.183	0.132	0.124	0.117	0.080	0.078	
$C_c$	Fit Data to $C_s, D_{app,C}$	[mass %]	0.530	0.458	0.391	0.329	0.275	0.230	0.192	0.162	0.139	0.122	0.089	0.085	0.085	$\sum (C_m - C_s)^2$
$(C_m - C_s)^2$	Sum of least squares			6.72E-05	3.76E-04	1.10E-05	9.01E-05	1.55E-06	2.93E-04	4.34E-04	5.00E-05	4.66E-06	8.12E-04	2.66E-05	4.90E-05	2.22E-03
$C_o$	Initial chloride content (measured)	[mass %]	0.085													
t	Exposure time	[yr]	1													
$C_s$	Chloride content at exposed face	[mass %]	0.605													
$D_{app,C}$	Apparent coefficient of chloride diffusion	[mm <sup>2</sup> /yr]	15.324													



# Implementation Products – Dedicated Webpage

The screenshot shows the AASHTO SHRP2 SOLUTIONS website. The header features the AASHTO logo and a navigation menu with links: About AASHTO, Bookstore, Software, Meetings, Committees, Programs, Newsroom, and Employment. Social media links for Twitter, Facebook, and YouTube are also present. The main content area is titled 'Service Life Design for Bridges' and includes a breadcrumb trail: AASHTO > Strategic Highway Research Program 2 > Service Life Design for Bridges. The page is divided into three main sections: 'Product Overview', 'Presentations and Webinars', and 'Tools and Technologies'. The 'Product Overview' section provides a brief description of the product and lists the 'SHRP2 Service Life Design Guide For Bridges Document'. The 'Presentations and Webinars' section lists three items: 'Concept Overview presentation: Durability Design Structure Birth Certificate', 'Product Detail presentation: Integrating Durability and Structural Design', and 'Service Life Design for Bridges Progress Update Webinar'. The 'Tools and Technologies' section is further divided into 'Reports' (listing 'Durability Assessment of a Bridge Substructure (R19A)') and 'Design Tools' (listing 'Service Life Design – Graphical Solution' with sub-links for 'Calculations Instructions' and 'Oregon Charts', and 'Service Life Design – Full Probabilistic Tools'). A sidebar on the left contains a 'SHRP 2' menu with links to Home, Implementation Assistance, Upcoming Events, SHRP2 Presentations, Products by Focus Area, Products by Topic Area, and News and Videos. Below this is a 'Need More Information?' section with contact information for Pamela Hutton, SHRP2 Implementation Mgr, including her email (phutton@aaashto.org) and phone number (303-263-1212).

**AASHTO**

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**AASHTO** **SHRP2 SOLUTIONS**  
TOOLS FOR THE ROAD AHEAD

**SHRP 2**

- Home
- Implementation Assistance
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**Need More Information?**

Pamela Hutton  
SHRP2 Implementation Mgr  
phutton@aaashto.org  
303-263-1212

**Service Life Design for Bridges**

AASHTO > Strategic Highway Research Program 2 > Service Life Design for Bridges

**SERVICE LIFE DESIGN FOR BRIDGES (R19A)**

**Product Overview**

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

- [SHRP2 Service Life Design Guide For Bridges Document](#)

**Presentations and Webinars**

- [Concept Overview presentation: Durability Design Structure Birth Certificate](#)
- [Product Detail presentation: Integrating Durability and Structural Design](#)
- [Service Life Design for Bridges Progress Update Webinar](#)

**Tools and Technologies**

**Reports**

- [Durability Assessment of a Bridge Substructure \(R19A\)](#)

**Design Tools**

- [Service Life Design – Graphical Solution](#)
  - [Calculations Instructions](#)
  - [Oregon Charts](#)
- [Service Life Design – Full Probabilistic Tools](#)

- <http://shrp2.transportation.org/Pages/ServiceLifeDesignforBridges.aspx>

# IAP Projects





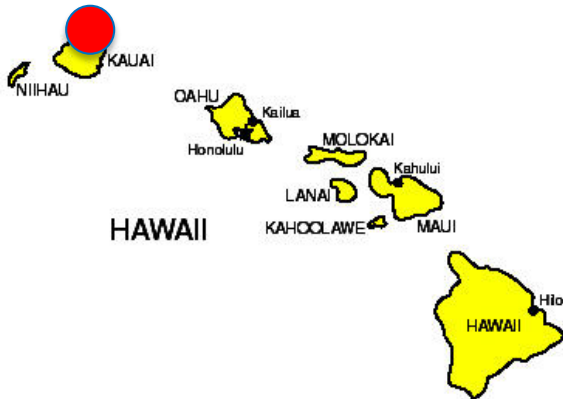
# IAP Team Leaders



- FHWA Central Federal Lands
  - Bonnie Klamerus, Mike Voth
- Iowa DOT
  - Ahmad Abu-Hawash, Norm McDonald
- Oregon DOT
  - Bruce Johnson, Paul Strauser, Zach Beget, Ray Bottenberg, Andrew Blower, Craig Shike
- Pennsylvania DOT
  - Tom Macioce
- Virginia DOT
  - Prasad Nallapaneni, Soundar Balakumaran

# FHWA Central Federal Lands

- **Tropical Coastal Exposure on North Shore, Island of Kauai, HI**
  - 3 bridge replacements - 500' to 1,000' from the coastline



# FHWA Central Federal Lands

The logo graphic for the Federal Highway Administration (FHWA) is located in the top right corner. It consists of several parallel, diagonal lines of varying lengths, all pointing towards the top right corner, creating a sense of motion and direction.

- Testing brackish water salinity
- Coring of existing abutments at water line / splash zone for surface chloride concentration
- NT Build 492 tests performed on baseline concrete mix designs

- **New Bridge at Site with Extreme De-Icing Spray Exposure**



- Using A1010 High Chromium Structural Steel
- Lab and field testing A1010 for steel corrosion resistance performance
- Recommendations from ODOT experience - Hormoz Seradj

- **Replacement of Twin Structures on I-35 over South Skunk River near Ames**



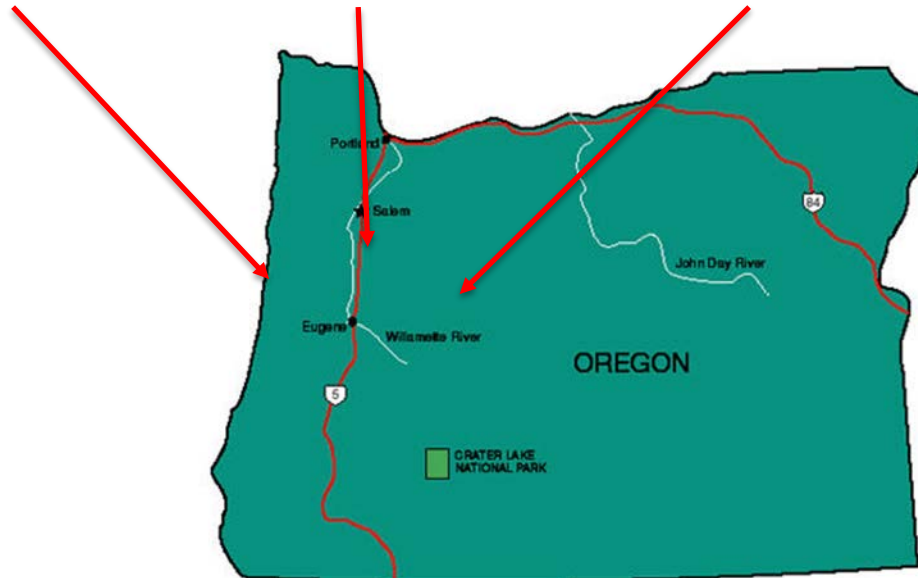
- Chloride profile testing on existing structures
- NT Build 492 tests on concrete mix designs
- SB Bridge – Designed to current Iowa DOT policies
- NB Bridge – Will be designed using SLD
- Final Product – Side-by-side comparison report between the two structures



- **Replacement of Beals Island Bridge in cold weather coastal environment**
  - Chloride profiling on existing bridge
  - NT Build 492 tests on proposed concrete specifications



- **Bridge Deck Evaluation in Various Chloride Exposure Zones**
  - Performed chloride profile testing and categorization of chloride loading by geographic/climatic zones (Pacific Coast, Willamette Valley, Cascade Mountains and east)



- **I-5 Columbia River Crossing Design/Build – Portland to Vancouver**
  - Evaluate/modify RFP requirements for contractor to design/document to a 100-year service life
- **Replacement Bridge over Ochoco Creek in Prineville**



- **Statewide Evaluation of Chloride Resistance of Concrete**
  - Performed NT Build 492 tests on 105 samples from 7 ready mix and 2 precast concrete suppliers



Figure 1: Company location map relative to PennDOT districts

# Lessons Learned





# Lessons Learned



- Chloride profiling on core samples produce much better results than powder samples from rotary drilling
- Deicing application is low enough in some parts of Oregon to disregard corrosion from chlorides
- Need to develop contour maps of chloride loading
- Chloride migration tests (NT Build 492) are relatively easy to implement
  - Virginia and Iowa performing in-house testing

# Lessons Learned

- Most state concrete classifications are flexible in w/c ratio, and % flyash or slag replacing cement
- Mix design flexibility  $\neq$  Consistent durability properties
  - Chloride migration test values (NT Build 492)
  - Aging coefficients (need  $\geq 20\%$  flyash to benefit)
- Need to develop guidelines for more consistent concrete specifications for SLD

# IAP Next Steps



- Conduct Agency Final Training Workshops for CFL, IA, OR, ME
- Develop Reference Material Documentation / add to AASHTO/SHRP2 web page
  - Academic Toolbox
  - Lessons Learned Summaries
- Develop 5 FHWA Peer Exchanges in non-IAP states

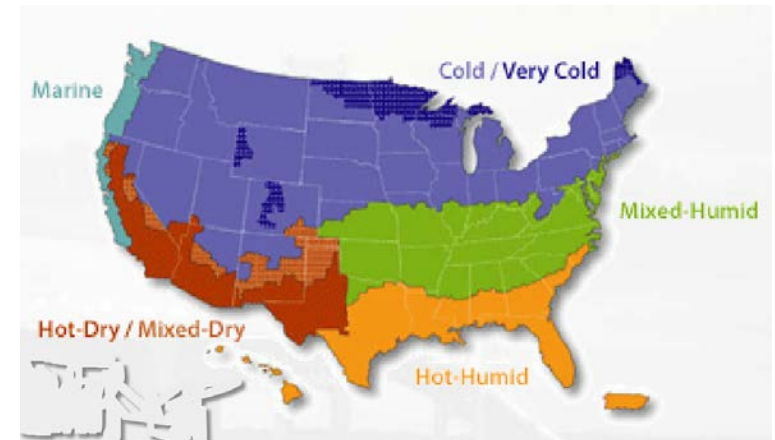
# Current Research - NCHRP 12-108



- Uniform Service Life Design Guide Specification
  - Sponsored by AASHTO T-9 – Bridge Preservation Technical Committee
  - Modjeski & Masters / John Kulicki / Rutgers University / COWI / NCS GeoResources
- Project Goals
  - Develop AASHTO Guide Specification for Service Life Design of Highway Bridges
  - Develop Case Studies to Demonstrate the Application of the Proposed Guide

# Current Research - NCHRP 12-108

- Deemed-to-Satisfy and Avoidance of Deterioration Strategies to form the majority of the Guide Specification
  - Calibrated by more rigorous approaches
- Full Probabilistic and Partial Factor Methods
  - Included as an Appendix
- Environmental Classification
- Recommended Service Life
  - Main Structure Components
  - Replaceable Components
    - Bearings, Joints, etc.



# Current Research – NCHRP 12-108

- Work Plan / Schedule

- Tasks 1 & 2 – Literature Review and Synthesis
- Task 3 – Develop Proposed Methodology
- Tasks 4a & b – Propose Annotated ToC & Case Studies
- Task 5 – Interim Report #1  
(all completed 03/10/17)
- Tasks 6, 7 & 8 – Develop & Execute Methodology & Sample Section & Interim Report #2 (scheduled 10/01/17)
- Tasks 9 & 10 – Develop Guide and Case Studies (scheduled 07/01/18)
- Tasks 11 & 12 – Revisions & Final Deliverables (scheduled 12/01/18)
- End of Project (scheduled 02/28/19)



# Summary

- Service Life Design is necessary to promote more durable, longer lasting structures
- Current implementation
  - SHRP2 R19A projects (FHWA CFL, IA(2), ME, OR, PA, VA)
- Tools being developed to assist designers
  - <http://shrp2.transportation.org/Pages/ServiceLifeDesignforBridges.aspx>
- AASHTO T-9 Initiated Research
  - NCHRP 12-108 Uniform Service Life Design Guide

# Questions?

## Implementation Leads:

- Patricia Bush, *AASHTO Program Manager for Engineering*, [pbush@aashto.org](mailto:pbush@aashto.org)
- Raj Ailaney, *FHWA Senior Bridge Engineer*, [Raj.Ailaney@dot.gov](mailto:Raj.Ailaney@dot.gov)

## Subject Matter Expert Team:

- Mike Bartholomew, *CH2M*, [mike.bartholomew@ch2m.com](mailto:mike.bartholomew@ch2m.com)
- Anne-Marie Langlois, *COWI North America*, [amln@cowi.com](mailto:amln@cowi.com)

## Resource: AASHTO's R19A Product Page

- <http://shrp2.transportation.org/Pages/ServiceLifeDesignforBridges.aspx>