

FY2022 NCHRP PROBLEM STATEMENT OUTLINE

SERVICE LIFE ESTIMATES FOR VARIOUS BRIDGE DECK PRESERVATION TREATMENTS

I. PROBLEM TITLE

Develop service life estimates for various bridge deck preservation treatments based on condition data collected from bridge owners and to have the service life values reflect traffic volumes, climate, and the condition of the asset prior to treatment.

II. BACKGROUND

Bridge preservation is a cost-effective approach to manage an inventory of bridges and owners are looking for quantitative tools to measure the value of bridge preservation treatments. The bridge deck element is subject to wear and tear caused by the traffic on the bridge and the environmental conditions including extreme temperatures and the application of de-icing chemicals. Bridge owners periodically apply preservation actions such as applying deck sealers and overlays to extend the life of the deck, but it has been a challenge to accurately quantify the benefit of those actions.

The research will address two challenges in the estimation of service life for various bridge deck preservation treatments:

1. The expected service life of the same bridge deck preservation treatment is not uniform across the State DOTs. The variances in the application of deck treatments produce differences in the effective service life. The variances in application of treatments include:
 - the age of the deck at the time of treatment
 - the condition of the deck at the time of treatment
 - decks with or without extensive repair before treatment
2. The service life of the treatments are not static over time. New or refined materials, design details and application procedures combine to vary the performance of treatments.

The research will gather comprehensive data from the DOTs and other sources of bridge condition information to include treatments history, traffic, and environmental data.

The research will combine three streams of information to generate an estimate of service life for deck treatments. The first is condition data for bridge decks; data are available as general condition ratings, and as bridge element condition data. The second is the treatment history of bridge decks and includes the type of treatment and the year of application. The third data set will be on relevant external variables, such as traffic and climatic influences.

Through a comprehensive statistical analysis, treatment service life models will be developed to describe the performance of the treatment over time as influenced by the condition of the deck at the time of treatment, traffic volumes and environmental factors. The analysis will also examine the treatment impact to the underlying bridge deck by comparing the condition of the deck at the time of treatment and at the end of the treatment service life. The models will provide both basic treatment performance information that can be used by any agency for planning purposes, as well as statistical models that can be utilized in decision support tools that facilitate bridge level preservation decisions.

This research supports the FHWA Bridge Preservation Expert Task Group's Strategic Plan Action Item #4, Determine Durations of Bridge Preservation Treatments from a Bridge Condition Rating Perspective and Action Item #5, Next Generation Data Framework for Developing Data-Driven Preservation Performance Estimates.

In addition, the AASHTO Transportation System Preservation Technical Services Program (TSP2) research group has identified and prioritized the research need to develop a "database of preservation activities and associated performance metrics".

III. LITERATURE SEARCH SUMMARY

NCHRP 14-23 [Discontinued] Practical Bridge Preservation Actions and Investment Strategies, and NCHRP 14-36 [Active] Proposed AASHTO Guide for Bridge Preservation Actions will be consulted as part of this study. Other research on deck deterioration and treatment impact models from scientific journals such as the Transportation Research Record and the ASCE Library.

IV. RESEARCH OBJECTIVE

The objective of this proposed research is to:

- Develop performance models to reflect the service life of various concrete bridge deck treatments based on data collected from bridge owners including deck condition (GCR and element level condition data), age and history of repairs, traffic volumes and environmental factors.
- Determine treatment impact models to reflect the condition of the concrete deck during the life of the preservation treatment by comparing the condition at the time of treatment and at the end of the treatment service life.

The following tasks and research outputs will be developed:

Task 1 Background & Method

The proposed study of the service life of deck treatments will build on recent studies and will use available data. Task 1 will include:

- A literature search on recent work in the performance of deck treatments
- A review of available data related to deck treatments and deck conditions (bridge component data (general condition rating) and bridge element data) in the National Bridge Inventory, in bridge management systems, and in States' expansions to data such as agency-developed condition ratings and agency-developed bridge elements

Task 1 will also review and develop methods to estimate service life of deck treatments. Methods using general condition ratings, bridge element conditions, and agency developed data are of special interest.

Task 1 provides the basis for detailed work in Tasks 2, 3 and 4.

Task 2 DOT Participation, DOT Data

Data for the study will be collected from Federal sources ⁽¹⁾⁽²⁾ and from State DOT sources. Data from DOT's will include:

- Records of types and year of treatment applied at individual bridge decks
- Agency bridge condition data history (deck general condition rating and bridge element data)

- Agency developed condition, especially agency developed elements for specific types of wearing surfaces.

Task 2 will recruit State DOT participants and will form requests for specific data from each DOT.

Task 2 will collect data and will assemble a database that combines all inputs into a uniform format of deck treatment and condition history.

Task 3 - Service Life of Deck Treatments

Task 3 will apply methods of Task 1 to data of Task 2. Estimates of service life will be generated for various partitions of data. For each treatment, service life will be estimated for:

- Type, existence and count of different overlays and sealers
- Newer decks or older decks
- Decks in better condition or poorer condition
- Decks with extensive repair before treatment or with lesser repair before treatment
- External factors (traffic, climate etc.)

Task 4 Manual of Practice

Methods that employ bridge component data (GCR) and element data or combinations of these can be used by bridge owners to form agency specific estimates of service life of treatments in ongoing management of bridge decks. Owners could update estimates of service life of treatments as more data become available. Owners could estimate service life of treatments that use new materials or methods. Task 4 will create a technical manual for use by bridge owners to estimate service life of deck treatments.

Task 5 Final Report

Task 5 will prepare a final report of methods, data, and findings of the study. The final report will include a comprehensive list of estimates of service life of concrete deck treatments.

References

- (1) FHWA (2020). Download NBI ASCII files. <https://www.fhwa.dot.gov/bridge/nbi/ascii.cfm>
- (2) FHWA (2020). Download NBI Element Data. <https://www.fhwa.dot.gov/bridge/nbi/element.cfm>

V. URGENCY AND POTENTIAL BENEFITS

There is overwhelming consensus in the bridge preservation community of the need to arm bridge engineers with data driven metrics to help them compete for the limited resources to manage their inventory, and currently they lack the quantitative tools to support bridge preservation efforts. The bridge manager must be able to make a compelling argument that bridge preservation projects are wise investments and save money for the bridge owner. This research will provide more of the metrics the bridge owner needs to make a strong case and help push forward bridge preservation programs nationwide.

The information from this research can also be used to demonstrate how the method of data collection and analysis can be used as a framework for establishing an evaluation tool of various bridge preservation activities and treatments.

This study will augment the FHWA Bridge Deck Preservation Portal currently to be developed under the Pooled Fund Study TPF-1540. This research may augment the research performed

through the Transportation Pooled Fund Study TPF-5(432) Bridge Element Deterioration for Mid-West States.

VI. IMPLEMENTATION CONSIDERATIONS AND SUPPORTERS

Bridge managers at DOT's and local agencies will benefit from the data driven service life estimates as they promote and deliver bridge preservation projects. The results from the research can be used immediately to justify increased funding for bridge preservation, it will provide bridge owners the confidence to invest in cost-effective bridge preservation strategies, and may serve as a gateway for additional research and analysis of treatments for other bridge elements.

The AASHTO Committee on Bridges and Structures, and specifically the Technical Committee T-9 Bridge Preservation and T-18 Bridge Management, Evaluation, and Rehabilitations will be most interested in the research results.

VII. RECOMMENDED RESEARCH FUNDING AND RESEARCH PERIOD

Recommended Funding: \$750,000.00
Research Period: 18 months

VIII. PROBLEM STATEMENT AUTHOR

The FHWA Bridge Preservation Expert Task Group

IX. OTHERS SUPPORTING THE PROBLEM STATEMENT

James S. Nelson, Chair, AASHTO Technical Committee on Bridge Preservation (T-9)
Jeffrey L. Milton, Chair, Bridge Technical Working Group, AASHTO Committee on Maintenance
Michael Brown, Chair, TRB Standing Committee on Bridge Preservation (AKT60)
Basak Aldemir Bektas, Chair, TRB Standing Committee on Bridge and Structure Management (AKT50)
George Hearn, Chair, TRB Standing Committee on Structures Maintenance (AKT40)

X. POTENTIAL PANEL MEMBERS

James S. Nelson, Director Bridges and Structures Bureau
Iowa Department of Transportation
800 Lincoln Way, Ames, IA 50010

Jeffrey L. Milton, Bridge Preservation Specialist
Structure and Bridge Division
Virginia Department of Transportation
4219 Campbell Avenue, Lynchburg, VA 24501

XI. PERSON SUBMITTING THE PROBLEM STATEMENT

Mr. Raj Ailaney PE
FHWA – Office of Bridges and Structures
Office of Infrastructure
1200 New Jersey Avenue, SE
Washington DC 20590

202.366.6749

raj.ailaney@dot.gov

DRAFT