FHWA's *Service Life Design Reference Guide*

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As our transportation infrastructure ages and inventories expand while budgets shrink, agencies realize that timely preventive maintenance and preservation activities are necessary to ensure the proper performance of transportation assets. Preventive maintenance and preservation enable state departments of transportation to increase the return on their infrastructure investment. With the implementation of Moving Ahead for Progress in the 21st Century Act (MAP-21) and Fixing America's Surface Transportation (FAST) Act, preservation is recognized as a vital component of achieving and sustaining a desired state of good repair of highway facilities. As such, preservation work is both eligible—Section 1103 of MAP-21 amended the definition of "construction" in 23 U.S.C. § 101—and encouraged under the National Highway Performance Program and the Surface Transportation Block Grant Program.

Improving infrastructure resilience is one of the U.S. Department of Transportation's strategic objectives.[1] While initial design for strength and serviceability is important to build a safe structure, it is equally important that there is a predefined strategy for preservation of bridge elements under environmental and operational loads so that the structure does not suffer capacity reduction. This preservation strategy contributes to the robustness of a structure and prolongs its service life. The Bipartisan Infrastructure Law, enacted on November 15, 2021, also provides support for activities that increase the resiliency of the National Highway System by making changes to the National Highway Performance Program (23 U.S.C. § 119(b)).

Service life design principles have been gaining broader acceptance as a tool to improve the performance of existing highway bridges and to design new bridges for enhanced durability. The objective of service life design is to assess the potential deterioration mechanism affecting structural elements, and to design those elements to achieve a target service life duration.

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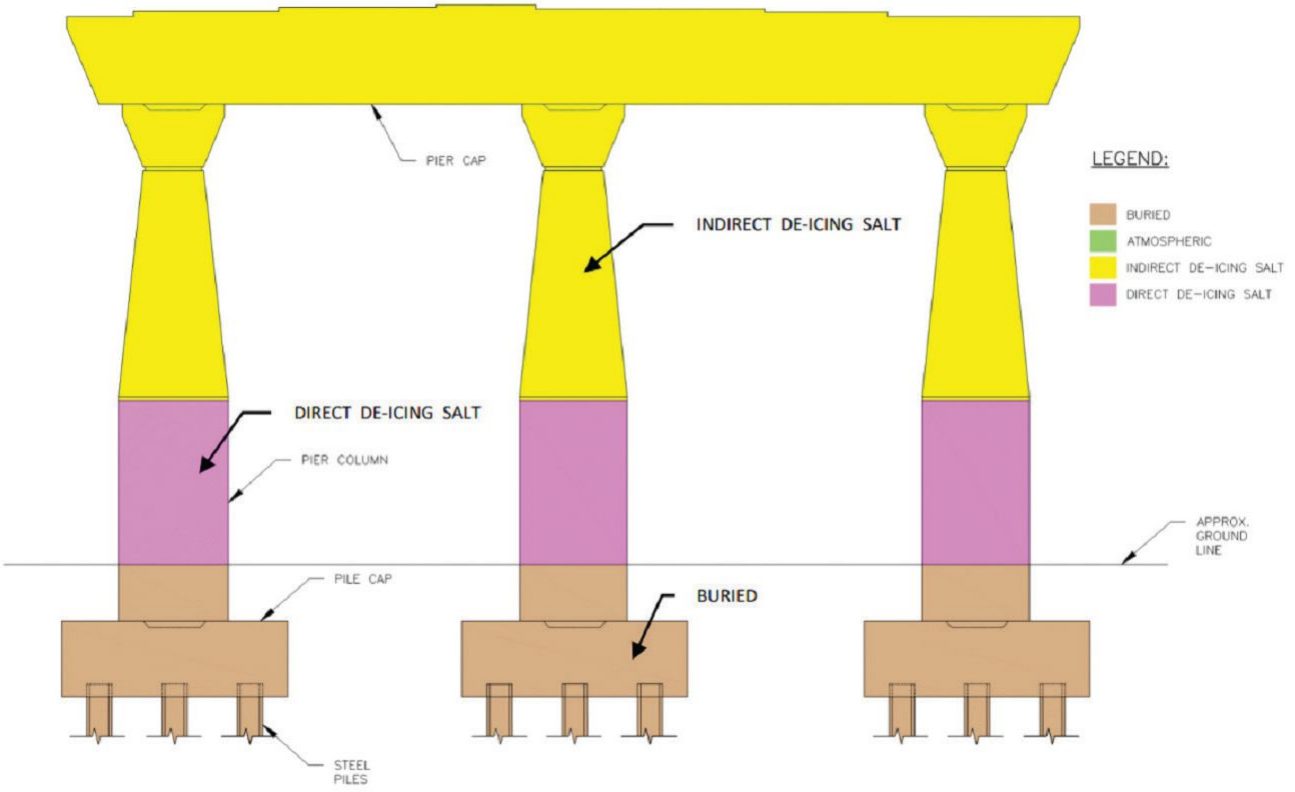
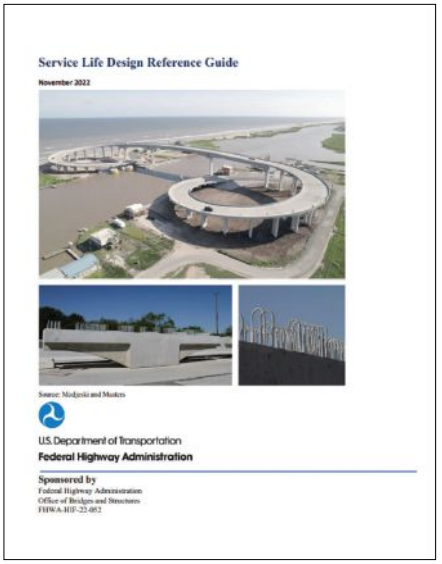
The Federal Highway Administration's *Service Life Design Reference Guide*[5] identifies exposure zones for piers depending on atmospheric conditions, water levels, and direct or indirect exposure to deicing salts. All Figures: Federal Highway Administration.





The Federal Highway Administration's *Service Life Design Reference Guide*[5] serves as a "road map" to service life design concepts and methods for bridge owners and designers.

Highway Research Program's research project R19A addressed the basis of service life design methodologies. Following that project, the National Cooperative Highway Research Program's 12-108 research project was initiated to create a specification for service life design principles and to demonstrate how the specification can be applied in typical design practice.[2] This project led to the publication of the American Association of State Highway and Transportation Officials' (AASHTO's) first *Guide Specification for Service Life Design of Highway Bridges* in 2020.[3]

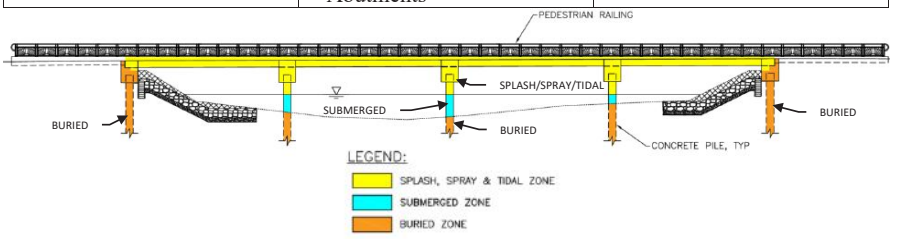
With the longtime implementation of the *AASHTO LRFD Bridge Design Specifications*,[4] engineers have become accustomed to reliability-based design procedures for limit-state criteria such as strength, extreme event, service, and fatigue. Satisfying a limit-state design provides a calibrated way of ensuring that the designed resistance will exceed the design demand by an acceptably low probability of demand exceeding resistance.

Bridge durability can be treated in the same manner. Where possible, the new AASHTO guide specification creates a durability limit state in which the potential deterioration mechanism can be resisted by the proper combination of material properties and design details (for example, concrete cover, concrete mixture design, location of expansion joints, and deck drainage). This design approach leads to an acceptably low probability of end-of-service-life deterioration occurring before the bridge reaches the owner's desired target service life. To date, full-probabilistic models are limited, and the AASHTO guide specification only has a calibrated limit state for chloride-induced corrosion for concrete structures reinforced with uncoated reinforcing steel, so it uses deemed-to-satisfy provisions based on practical experience.

Implementing new specifications can be challenging. So far, only large signature structures and a few historic bridges have been designed for specific service life criteria. Our focus should be to design routine structures that use the concepts of service life design by applying site-specific environmental exposure conditions and/or performance requirements, so that they are designed for the durability and target service life that an owner desires.

When the service life of a structure is evaluted, both the locations of bridge components and the local climate are considered in the environmental classification outlined in the *Service Life Design Reference Guide*.[5]

Exposure Zone	Elements	Description
Tidal or Water- Level zone	• Top of Deck, • Soffit of Girders, • Bents, • Piles, • Barriers • Railing • Approaches	Not permanently submerged in the water, subject to wet-dry cycles, 20 ft above the tidal zone
Marine-Submerged	• Piles	Permanently submerged in sea water
Buried	• Piles • Abutments	Permanently buried in soil



The Federal Highway Administration's (FHWA's) *Service Life Design Reference Guide*, published in November 2022, is a "road map" to service life design concepts and methods for bridge owners and designers.[5] This guide focuses on North American design practices and provides references for applying service life design principles to both concrete and steel highway bridges. It gives three examples for service life design that follow the information provided in the AASHTO guide specification.

On May 1, 2023, FHWA conducted a national webinar, "FHWA Service Life Design Reference Guide: How to Design Bridges that Last," with 42 states participating and more than 365 individuals in attendance. The webinar presented the available service life design methodologies, provided an overview of the new FHWA *Service Life Design Reference Guide*, and demonstrated the service life design process through an example. A recording of this webinar is available on the Bridge Preservation page of the FHWA website.[6]

Going forward, FHWA plans to conduct eight regional workshops, with the first occurring this fall and the series concluding in 2024. These workshops will be 1½ days long, specific to regional needs, and coordinated through the host state agency. They will be open to regional and state departments of transportation, consulting design engineers, and construction professionals.

References

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