Findings from FHWA Peer Exchange on Bridge Corrosion

Coatings & Corrosion Protection Part I

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FHWA Report No. FHWA-HF-23-064

DISCLAIMER

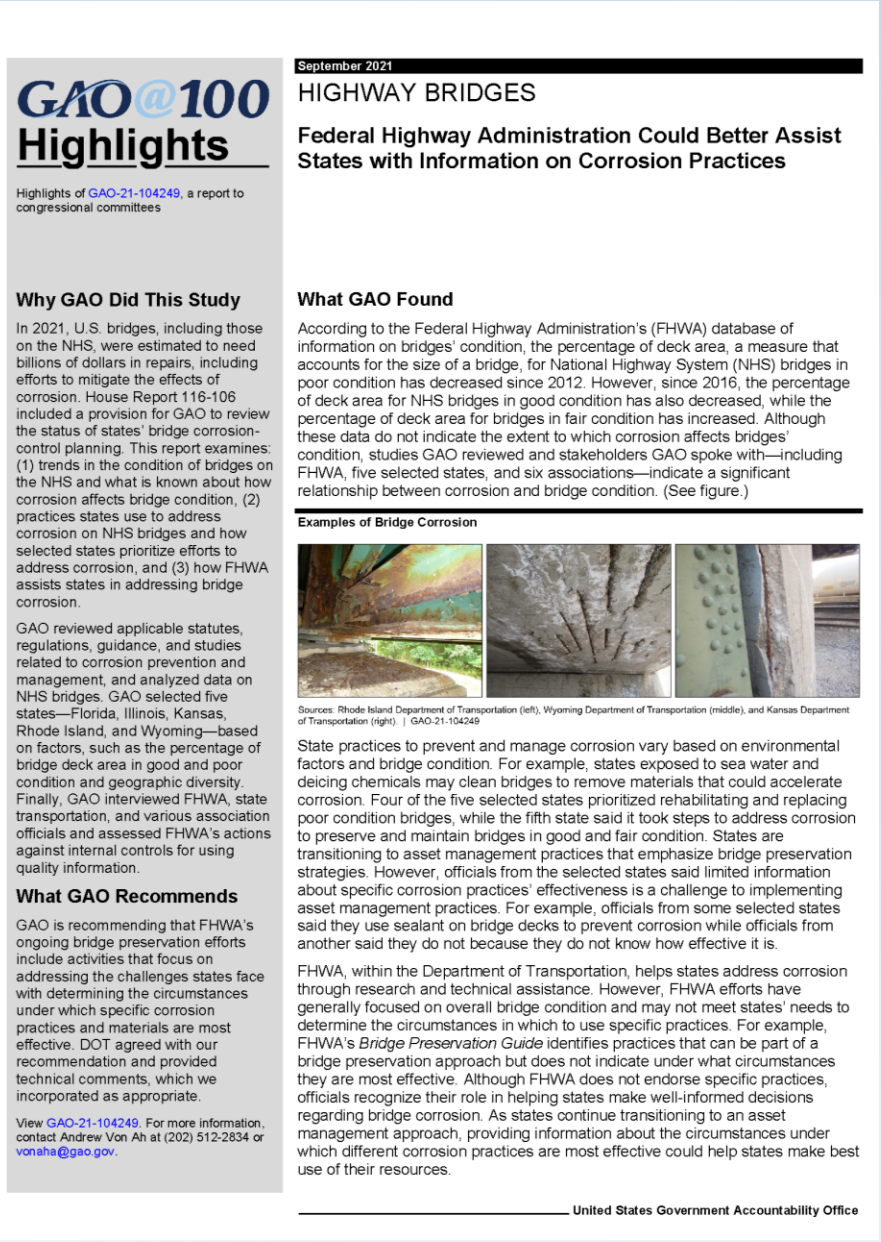
The contents of this presentation do not necessarily reflect the official view or policies of the Federal Highway Administration (FHWA). The content does not constitute a standard, specification, or regulation.

FHWA Report No. FHWA-HF-23-064
Corrosion Prevention and Mitigation
U.S. Government Accountability (GAO) Report

GAO-21-104249 Report – Federal Highway Could Better Assist States with Information on Corrosion Practices – September 2021

House Report 116-106 – Included a provision for GAO to review the status of States' bridge corrosion-control planning

- Trends in condition of NHS bridges –how corrosion affects bridge condition
- Practices States use to address corrosion on NHS bridges
- How FHWA assists States in addressing bridge corrosion



GAO@100 Highlights

Highlights of GAO-21-104249, a report to congressional committees

Why GAO Did This Study

In 2021, U.S. bridges, including those on the NHS, were estimated to need billions of dollars in repairs, including efforts to mitigate the effects of corrosion. House Report 116-106 included a provision for GAO to review the status of states' bridge corrosion-control planning. This report examines: (1) trends in the condition of bridges on the NHS and what is known about how corrosion affects bridge condition, (2) practices states use to address corrosion on NHS bridges and how selected states prioritize efforts to address corrosion, and (3) how FHWA assists states in addressing bridge corrosion.

GAO reviewed applicable statutes, regulations, guidance, and studies related to corrosion prevention and management, and analyzed data on NHS bridges. GAO selected five states—Florida, Illinois, Kansas, Rhode Island, and Wyoming—based on factors, such as the percentage of bridge deck area in good and poor condition and geographic diversity. Finally, GAO interviewed FHWA, state transportation, and various association officials and assessed FHWA's actions against internal controls for using quality information.

What GAO Recommends

GAO is recommending that FHWA's ongoing bridge preservation efforts include activities that focus on addressing the challenges states face with determining the circumstances under which specific corrosion practices and materials are most effective. DOT agreed with our recommendation and provided technical comments, which we incorporated as appropriate.

View GAO-21-104249. For more information, contact Andrew Von Ah at (202) 512-2834 or vonaha@gao.gov.

September 2021

HIGHWAY BRIDGES

Federal Highway Administration Could Better Assist States with Information on Corrosion Practices

What GAO Found

According to the Federal Highway Administration's (FHWA) database of information on bridges' condition, the percentage of deck area, a measure that accounts for the size of a bridge, for National Highway System (NHS) bridges in poor condition has decreased since 2012. However, since 2016, the percentage of deck area for NHS bridges in good condition has also decreased, while the percentage of deck area for bridges in fair condition has increased. Although these data do not indicate the extent to which corrosion affects bridges' condition, studies GAO reviewed and stakeholders GAO spoke with—including FHWA, five selected states, and six associations—indicate a significant relationship between corrosion and bridge condition. (See figure.)

Examples of Bridge Corrosion

Sources: Rhode Island Department of Transportation (left), Wyoming Department of Transportation (middle), and Kansas Department of Transportation (right). | GAO-21-104249

State practices to prevent and manage corrosion vary based on environmental factors and bridge condition. For example, states exposed to sea water and deicing chemicals may clean bridges to remove materials that could accelerate corrosion. Four of the five selected states prioritized rehabilitating and replacing poor condition bridges, while the fifth state said it took steps to address corrosion to preserve and maintain bridges in good and fair condition. States are transitioning to asset management practices that emphasize bridge preservation strategies. However, officials from the selected states said limited information about specific corrosion practices' effectiveness is a challenge to implementing asset management practices. For example, officials from some selected states said they use sealant on bridge decks to prevent corrosion while officials from another said they do not because they do not know how effective it is.

FHWA, within the Department of Transportation, helps states address corrosion through research and technical assistance. However, FHWA efforts have generally focused on overall bridge condition and may not meet states' needs to determine the circumstances in which to use specific practices. For example, FHWA's *Bridge Preservation Guide* identifies practices that can be part of a bridge preservation approach but does not indicate under what circumstances they are most effective. Although FHWA does not endorse specific practices, officials recognize their role in helping states make well-informed decisions regarding bridge corrosion. As states continue transitioning to an asset management approach, providing information about the circumstances under which different corrosion practices are most effective could help states make best use of their resources.

United States Government Accountability Office

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GAO’s Recommendation to FHWA

The Administrator of FHWA should ensure that FHWA's ongoing bridge preservation efforts include activities, such as peer exchanges and case studies that focus on addressing the challenges states face with determining the circumstances under which specific corrosion practices and materials are most effective. Preserve our assets and minimize their whole-life cost.

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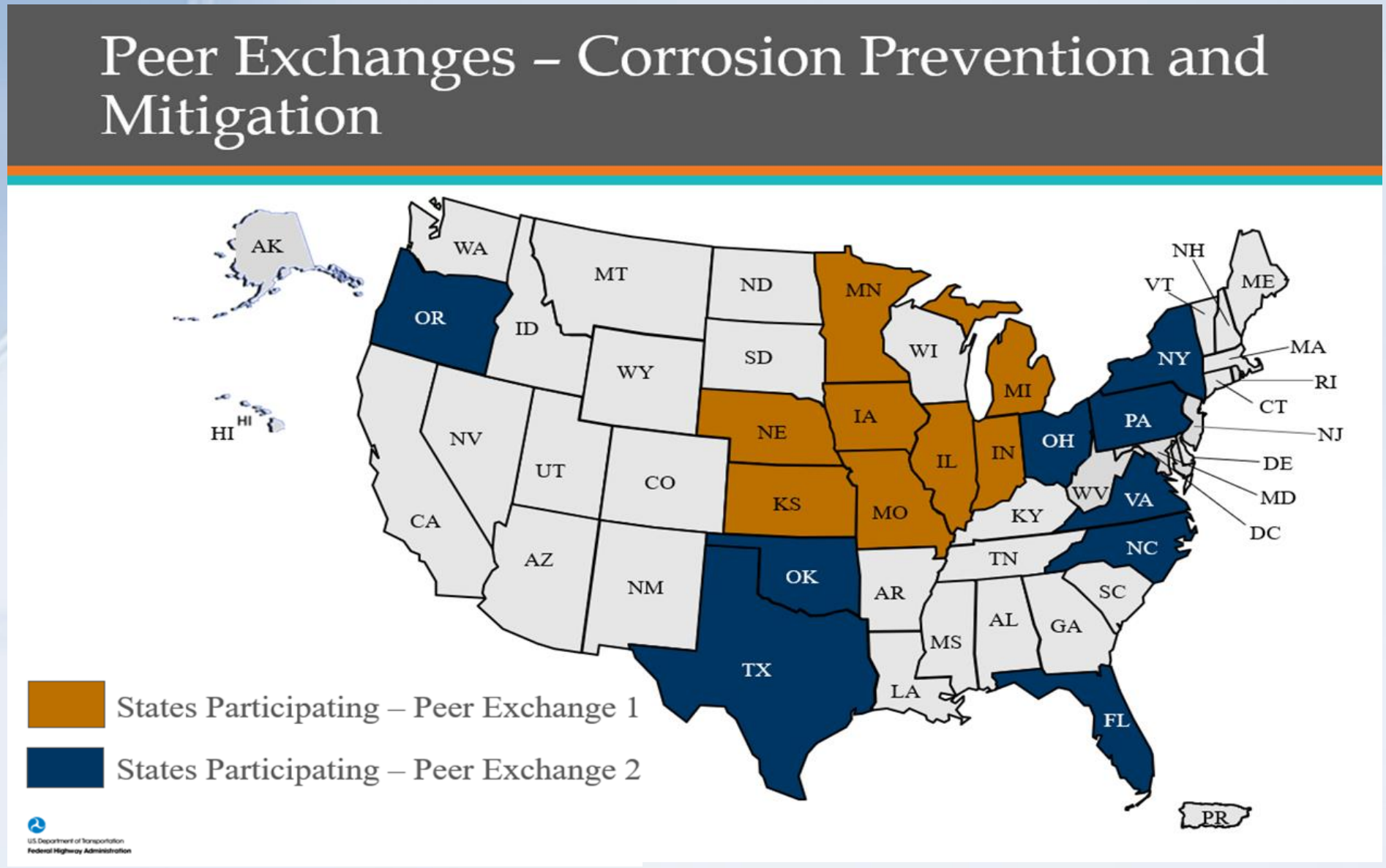
Two peer exchanges held:

- MN
- FL



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Prior to each of the peer exchanges, a half-day virtual meeting was held with all the State participants, with each State DOT making a presentation providing certain base-line data concerning:

- Organizational structure.
- Number of bridge assets managed.
- Agency challenges.
- Agency successes.
- Future endeavors with respect to corrosion prevention.
- Mitigation methods used for existing/in-service bridges.
- Challenges, successes, and future endeavors for new bridges under design (i.e., design standards and policies).

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Also prior to the peer exchanges, the selected States were asked to respond to a questionnaire to gain a better understanding of the following:

- Inventory of their NHS bridges.
- Type(s) of data they are collecting to identify and address corrosion issues.
- Actions they take to remediate the corrosion and the effectiveness of those actions.
- Design policies and procedures they follow to minimize/prevent corrosion from occurring in the future.
- Research they are undertaking on this topic.

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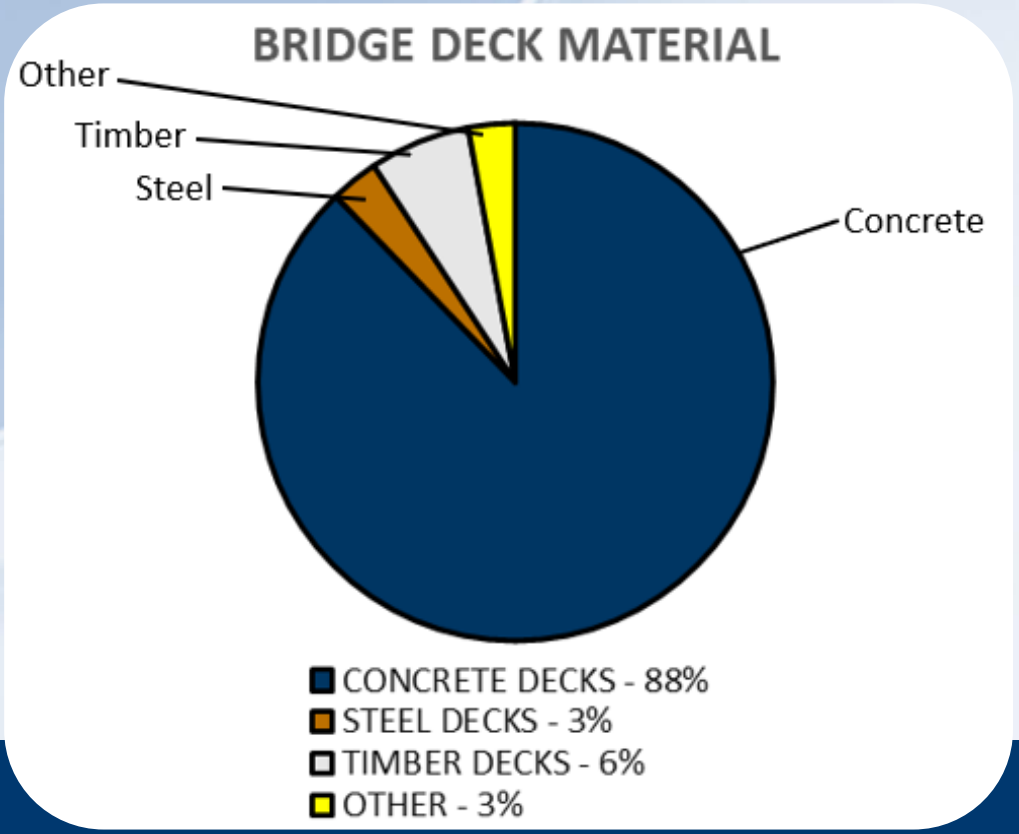
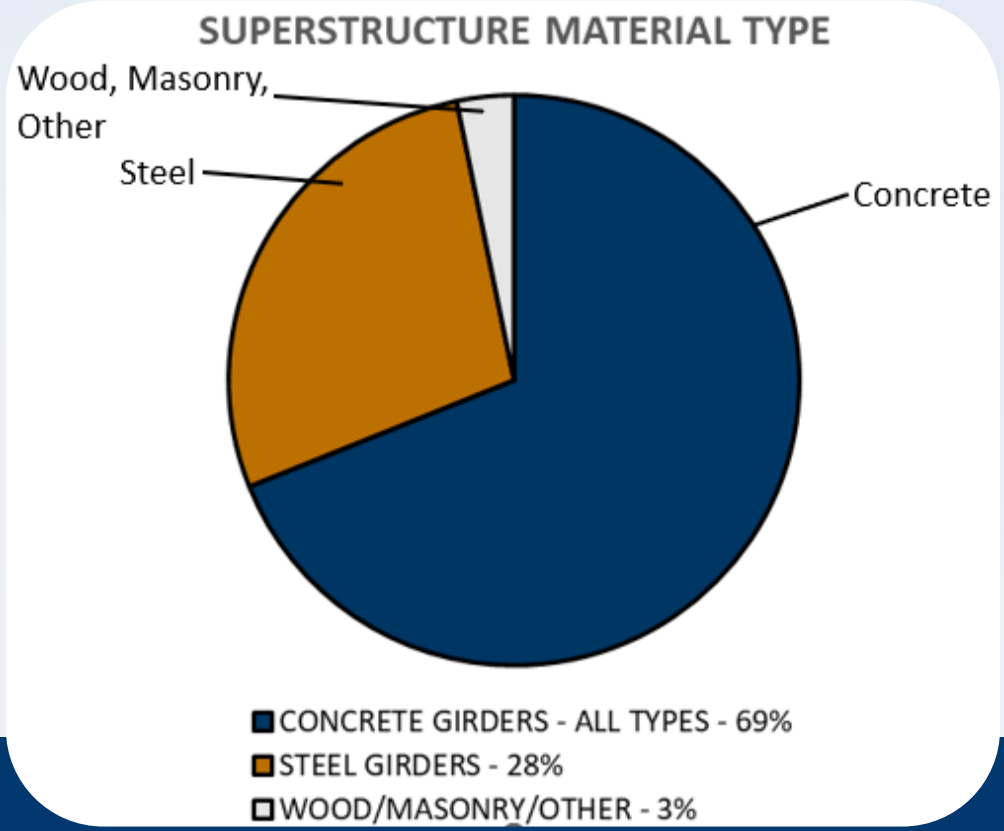
Peer Exchange Agendas focused on corrosion in:

- Concrete bridge decks.
- Steel and concrete superstructures.
- Steel and concrete substructures.





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Findings:

1. Actions States are undertaking to slowdown, reduce, and prevent corrosion from occurring to their existing bridges.
2. Policy changes States are making to their design standards, details, and material specifications to eliminate root causes of corrosion.

As noted previously, each of the above categories was striated into:

1. Decks
2. Superstructures
3. Substructures

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1. Preservation Actions for Decks
   - Sweeping and washing bridge decks to remove potential corrosive agents (chlorides).
   - Applying sealers to prevent, reduce and slow the infiltration of chloride laden water.
   - Installing protective overlays, e.g., either thin epoxy overlays, polyester polymer overlays, rigid (thick) concrete overlays or asphalt overlays with a membrane.
   - Replacing the bridge deck with corrosion resistant reinforcement, and using a concrete mix enhanced to minimize concrete porosity.

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1. Preservation Actions for Super & Substructures
   - Washing the superstructure and substructure. Especially areas under deck joints and flat surfaces like pier caps and bridge seats.
   - Removing corrosion (rust), repainting steel & strengthening. Strengthening may include concrete encasement of steel girder ends and steel piles in foundation elements.
   - Removing deteriorated concrete and patching, which may include the use of cathodic protection, and then sealing concrete elements, especially at the ends of beams, pier caps & bridge seats under deck joints, and other areas that may be exposed to salt spray like columns along the roadway.

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2. Changes to Design Standards, Details, and Material Specifications for New Deck Designs
   - Changing the concrete design mix to reduce the porosity of the concrete and reduce shrinkage cracking.
   - Require the placement of a concrete deck sealer or calling for the installation of a protective overlay during the initial construction.
   - Using non-corrosive reinforcement in the deck.




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2. Changes to Design Standards, Details, and Material Specifications for New Super & Substructure Designs
   - Specify steel elements with enhanced corrosion-resistant properties – weathering, galvanized or metalized steel, and proactively paint areas susceptible to corrosion such as at expansion joints.
   - Change concrete mix designs reducing the porosity of the concrete elements, or call for corrosion-resistant reinforcement, or use materials not susceptible to corrosion in the concrete beam/girder.
   - Require the sealing of concrete elements at known areas of high exposure.
   - Configure bridges w/o expansion joints, move expansion joints beyond the bridge, or reduce the number of expansion joints in new designs.

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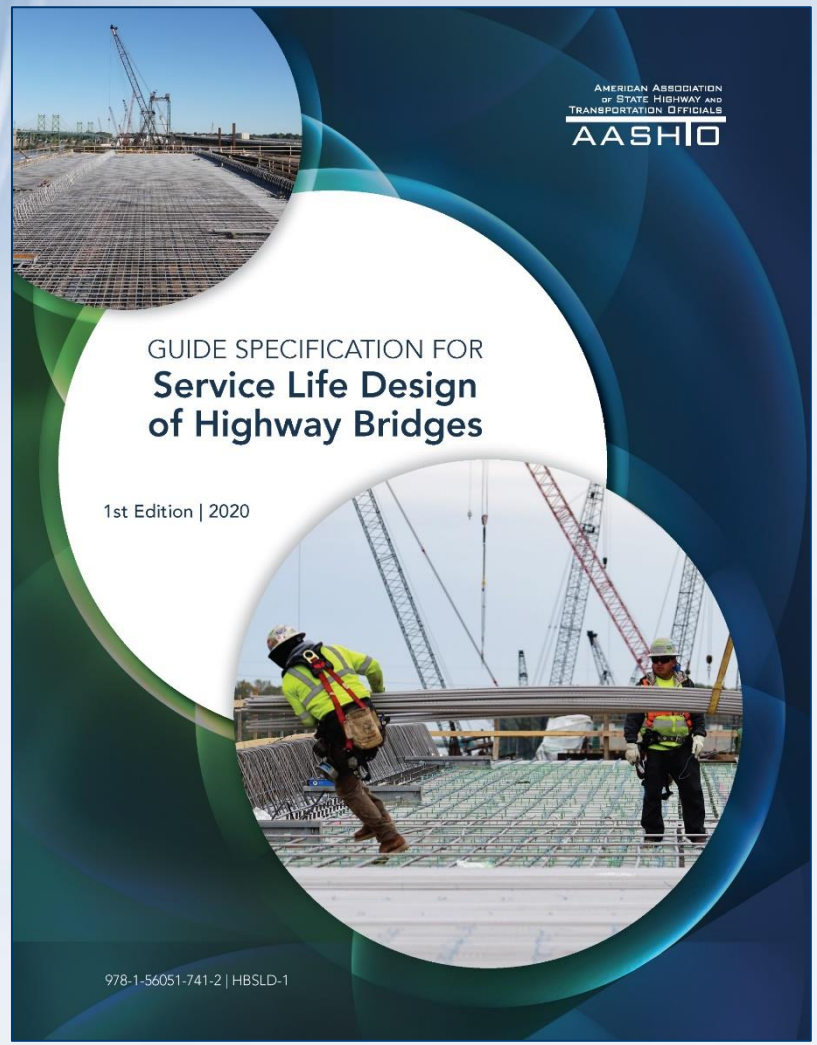
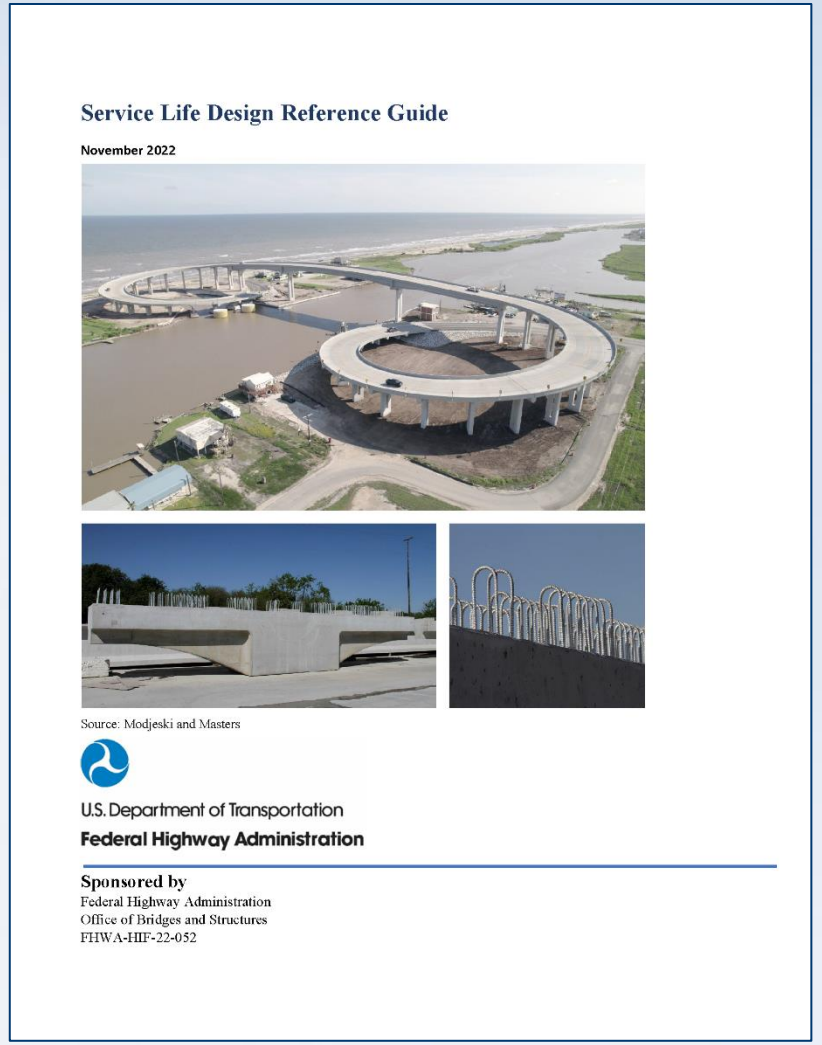
Changes to Design Standards, Details, and Material Specifications is also known as Service Life Design





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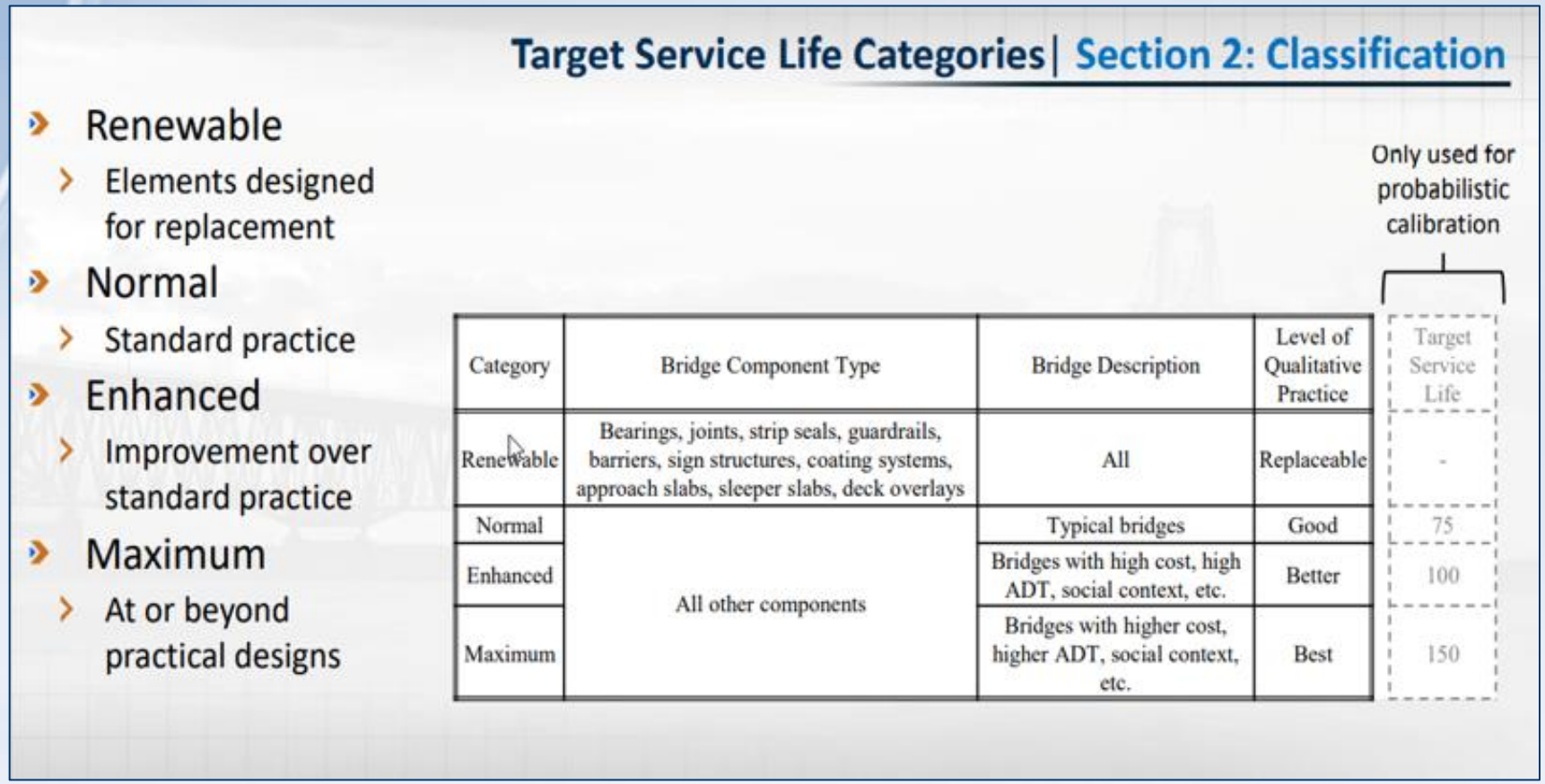
- From NCHRP Web-Only Document 269
- Guide Specification for Service Life Design of Highway Bridges



Target Service Life Categories | Section 2: Classification

- Renewable
  - Elements designed for replacement
- Normal
  - Standard practice
- Enhanced
  - Improvement over standard practice
- Maximum
  - At or beyond practical designs

Only used for probabilistic calibration

Category	Bridge Component Type	Bridge Description	Level of Qualitative Practice	Target Service Life
Renewable	Bearings, joints, strip seals, guardrails, barriers, sign structures, coating systems, approach slabs, sleeper slabs, deck overlays	All	Replaceable	-
Normal	All other components	Typical bridges	Good	75
Enhanced		Bridges with high cost, high ADT, social context, etc.	Better	100
Maximum		Bridges with higher cost, higher ADT, social context, etc.	Best	150

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MnDOT Example of Normal, Enhanced and Maximum

- Normal = 90-95% - 75 year
- Enhanced = 5-10% - 100 year
  - Cost>$20 million
  - ADT>60,000
  - Redecking complexities (curved, bifurcated, staging issues, etc.)
- Maximum = 1-5% - 100+ year
  - Cost >$35 million
  - Critical crossing (long detour, border bridge)
  - Redecking complexities (box girders)

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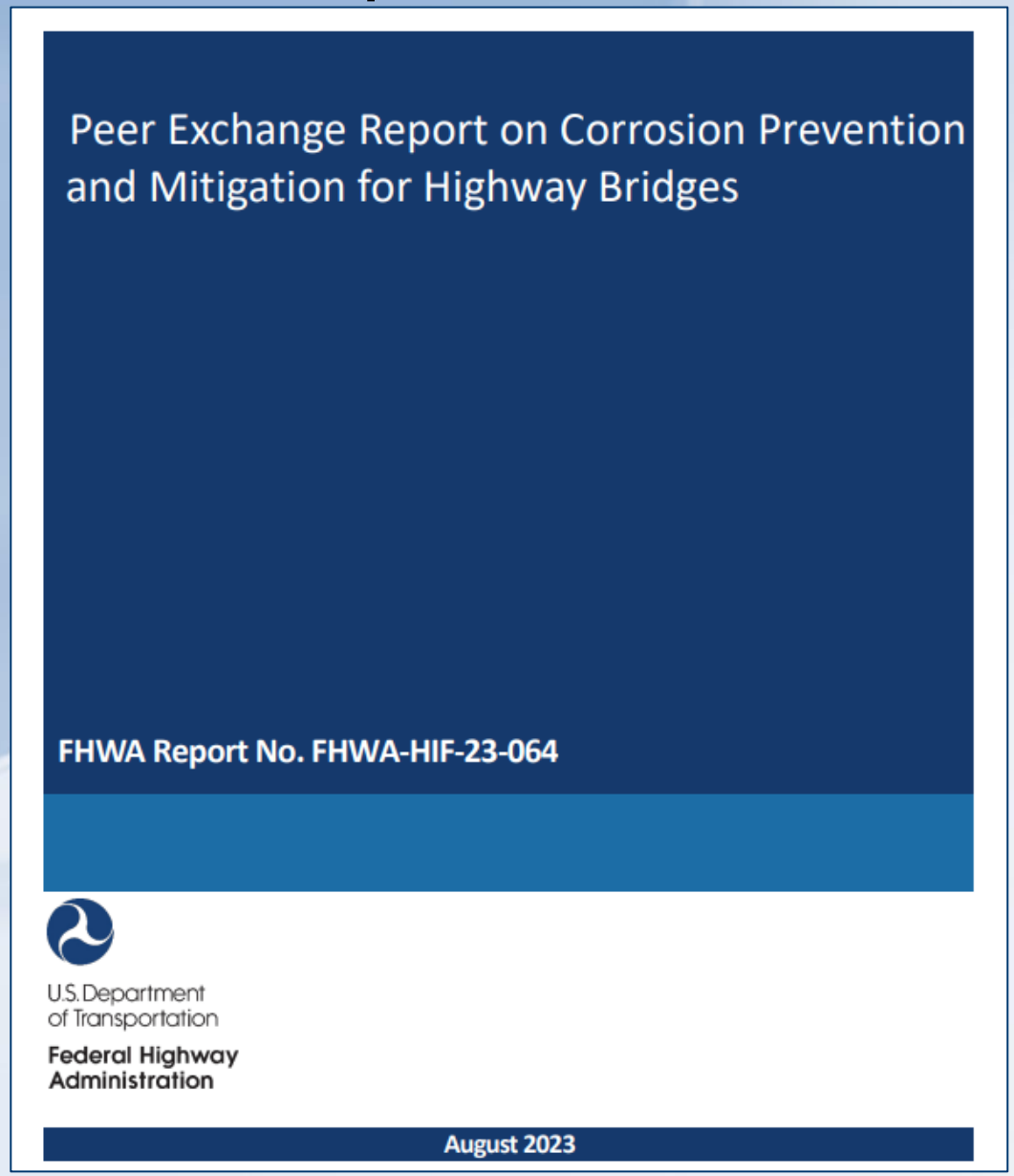

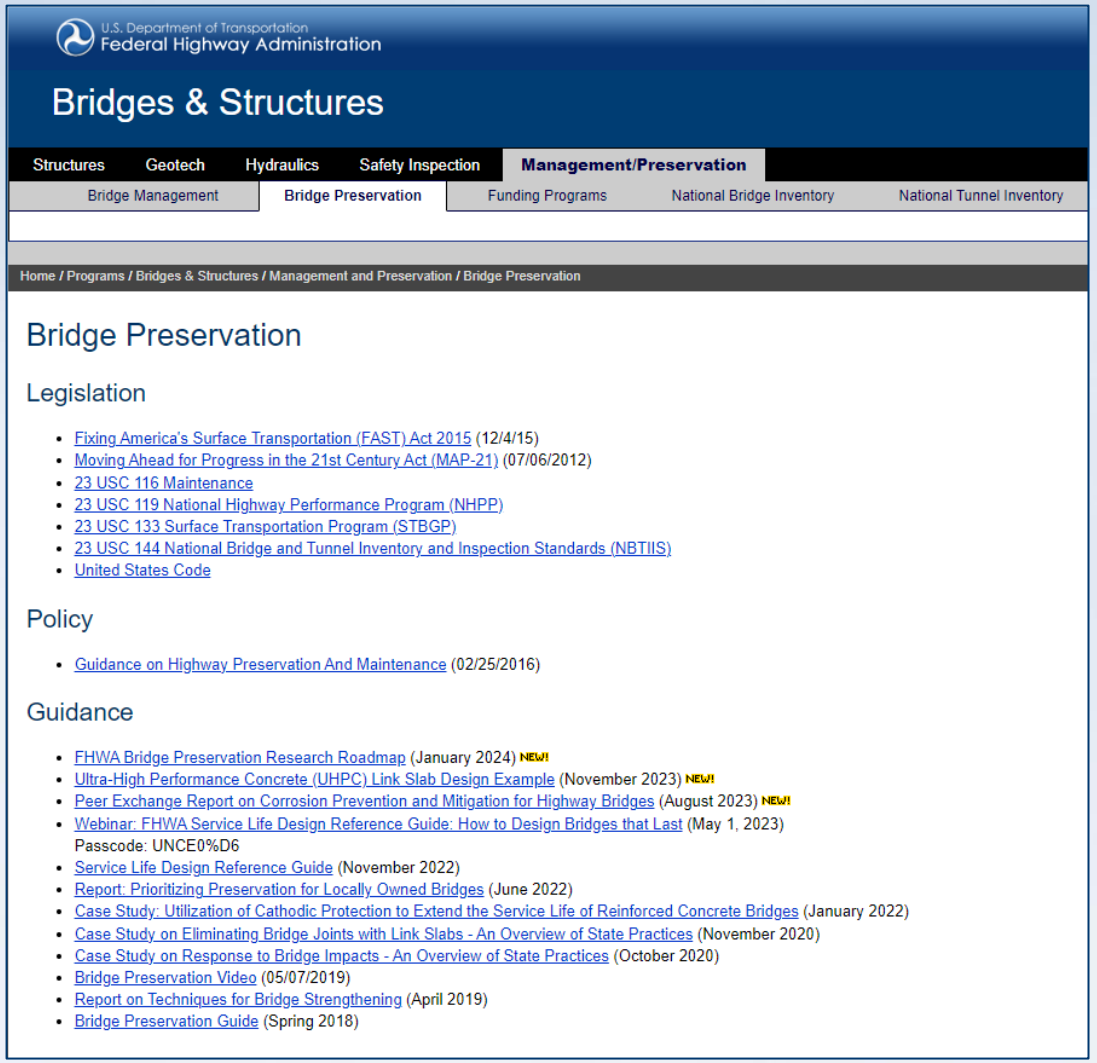

Bridge Preservation - Management and Preservation - Bridges & Structures - Federal Highway Administration (dot.gov)


Q
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Answer