

BRIDGE ADVISORY NUMBER: **BA-2023-01**

DATE: September 1, 2023

SUBJECT: **Inspection Finding Follow-up Actions for Uncoated Weathering Steel Bridges**

ISSUED BY: Creightyn McMunn, Structure Management Engineer

REVIEWED BY: Michael Halloran, Structure Program Division Administrator

Contact Information: Creightyn McMunn, Structure Management Engineer
McMunnC@michigan.gov or MDOT-Bridge-Data-Request@michigan.gov
Allie Nadjarian, Bridge Inspection Program Manager
NadjarianA@michigan.gov or MDOT-MiBridge-Admin@michigan.gov
Andrew Zevchak, Load Rating Program Manager
ZevchakA@michigan.gov or MDOT-Load-Rating@michigan.gov

FORBES AVENUE (FERN HOLLOW) BRIDGE COLLAPSE

The Fern Hollow Bridge was a three-span, continuous rigid “K” frame structure constructed using uncoated weathering steel, with a posted weight limit of 26 tons. Officially known as the Forbes Avenue Bridge over Fern Hollow in Pittsburgh, Pennsylvania, the bridge collapsed on January 28, 2022, while a bus and four passenger vehicles were crossing the bridge. Multiple occupants sustained injuries, including two vehicle occupants that sustained serious injuries.

REPORT HIR-23-07

On May 3, 2023, the National Transportation Safety Board (NTSB) released the report *Improving the Identification, Prioritization, and Completion of Follow-up Actions on Bridges with Uncoated Weathering Steel Components*, NTSB/[HIR-23-07](#). The report provides an update regarding their ongoing investigation into the collapse of the Fern Hollow Bridge, including preliminary findings and recommendations. The NTSB has not yet issued the final report, nor determined the probable cause of the collapse.

Per the report, “uncoated weathering steel refers to a group of alloy steels that are designed to, over time and with exposure to weather, form a protective patina that negates the need for painting or coating. Uncoated weathering steel is designed for use in environments that experience weather cycles with phases of wetting and drying. The dry periods are critical to the steel forming a protective oxide coating, or patina, that resists corrosion over time. The presence of ponding water and debris buildup can trap water on and around the bridge structure, prevent the steel from drying, and preclude the formation of the protective patina, which in turn enables corrosion and deterioration to occur and reduces the safety and service life of the uncoated weathering steel.”

Report HIR-23-07 highlights the importance of proper bridge maintenance and completion of recommended follow-up actions identified in National Bridge Inspection Standards (NBIS) inspection reports. The NTSB noted that the Fern Hollow Bridge inspection reports documented extensive corrosion damage and deterioration, including areas with 100% section loss in structural elements of all four bridge legs. These findings were confirmed during the on-scene investigation performed by the NTSB. In addition, drains blocked by debris, dirt and other materials led to improper drainage, which prevented the development of the weathering steel’s protective patina and resulted in section loss. Clogged drains and recommendations for associated maintenance work were also noted in the Fern Hollow Bridge inspection reports for many years prior to the collapse.

FHWA MEMORANDUM and MDOT ACTION PLAN

FHWA released a memorandum on July 19, 2023, providing direction regarding the in-service inspection, inventory and evaluation of bridges and bridge components fabricated from uncoated weathering steel. Pursuant to 23 CFR 650.313 and 650.315, FHWA directed the State DOTs to take specific actions, detailed in the attached memorandum, to ensure that a similar collapse does not occur elsewhere. MDOT developed the following action plan to address this directive.

- MDOT will identify bridges with potential weathering steel components, including:
 - SIA Item 77 – Steel Type coded as weathering steel (Code = 4, Alloy-weather, A588-A441 mod) superstructures
 - Any steel substructure element(s) (NBE 202, 207, 219, 225 or 231) defined during the most recent inspection
 - Complete Action By: September 8, 2023
- MDOT will make an initial assessment regarding Group 1 and Group 2 status for the list of bridges with potential weathering steel components. Per the FHWA Memorandum,
 - Group 1 consists of those bridges:
 - With uncoated weathering steel components in the substructure, or that are a rigid frame, and have a condition rating of 4 or less for the component containing the uncoated weathering steel element(s)
 - With uncoated weathering steel nonredundant steel tension members in the superstructure that have a superstructure condition rating of 4 or less
 - On the National Highway System with any uncoated weathering steel National Bridge Element (except bridge railings) with quantities in Condition State 4
 - Group 2 consists of all remaining bridges with uncoated weathering steel components.
 - Complete Action By: September 8, 2023
- MDOT will send the list of potential Group 1 and Group 2 bridges within each jurisdiction to the user(s) listed as the bridge owner for that jurisdiction in MiBRIDGE. Note that this list may include bridges with no weathering steel components and/or bridges with coated weathering steel components. Agencies are responsible for reviewing their inventory to verify that all bridges with uncoated weathering steel component(s) are included in this list.
 - Complete Action By: September 15, 2023
- Bridge owner(s) are required to verify the initial Group 1 and Group 2 assessment and [notify MDOT](#) of their findings.
 - If there are no weathering steel component(s) on a bridge, [notify MDOT](#) that the bridge should not be included in Group 1 or Group 2 and provide justification for the assessment.
 - If all weathering steel component(s) on a bridge are coated, [notify MDOT](#) that the bridge should not be included in Group 1 or Group 2 and provide justification for the assessment. Note that weathering steel bridges with zone or spot painting are considered uncoated and must be included in Group 1 or Group 2, as applicable.
 - If the initial Group 1 or Group 2 assessment is incorrect or incomplete, [notify MDOT](#) of the correct Group and provide justification for the revised assessment.
 - [Notify MDOT](#) of any bridges with uncoated weathering steel component(s) not included in this list.
 - Complete Action By: October 13, 2023

- MDOT will report the NBI structure numbers of all bridges in Group 1 to FHWA.
 - Complete Action By: October 31, 2023

- Bridge owner(s) are required to review inspection and maintenance records for each bridge in Group 1 to confirm that bridge inspector-recommended or otherwise recommended work items have been completed that address deficiencies resulting from poor performance of uncoated weathering steel, and that the current load rating for the bridge adequately and appropriately considers the documented deterioration and any completed work. It may be necessary to conduct a special inspection to document the severity and extent of the deterioration and/or update the load rating considering the documented deterioration.
 - For each bridge in Group 1, bridge owner(s) are required to [provide a quarterly update to MDOT](#) per the schedule below. Quarterly updates to MDOT are required until completion of the recommended work items is confirmed, and the load rating adequately and appropriately considers the documented deterioration and completed work. Quarterly updates must include:
 - If completion of the work has been confirmed, the month and year when the bridge inspector-recommended or otherwise-recommended work items addressing deficiencies resulting from poor uncoated weathering steel performance were completed.
 - If completion of the work has not been confirmed, the month and year when the extent of deterioration was documented.
 - The month and year when the bridge load rating was updated considering the severity and extent of the documented deterioration and any completed work.
 - Quarterly update schedule:

Quarter	Quarterly Update Deadline
11/1/23 – 12/31/23	1/12/24
1/1/24 – 3/31/24	4/12/24
4/1/24 – 6/30/24	7/12/24
7/1/24 – 9/30/24	10/11/24
10/1/24 – 12/31/24	1/10/25

 - Complete Action By: December 31, 2024
 - Complete Quarterly Updates By: January 1, 2025

- Bridge owner(s) are required to confirm during the next scheduled inspection of each bridge in Group 2 that all preventative maintenance or preservation activities necessary to ensure the satisfactory performance of the uncoated weathering steel component(s) are identified and communicated to those responsible for the maintenance of the structure.
 - For each bridge in Group 2, bridge owner(s) are required to [provide a quarterly update to MDOT](#) per the schedule above. Quarterly updates to MDOT are required until all preventative maintenance or preservation activities are identified and communicated to those responsible for the maintenance of the structure.
 - MDOT will notify FHWA when this task is complete for all bridges in Group 2.
 - Complete Action By: November 1, 2025



U.S. Department
of Transportation

Federal Highway
Administration

Memorandum

Subject: **ACTION**: Inspection Finding Follow-up Actions for
Uncoated Weathering Steel Bridges

Date: July 19, 2023

From: Joseph L. Hartmann, Ph.D., P.E.
Director, Office of Bridges and Structures

In Reply Refer To:
HIBS-1

To: Division Administrators
Directors of Field Services

The purpose of this memorandum is to provide direction regarding the in-service inspection, inventory, and evaluation of bridges and bridge components fabricated from uncoated weathering steel.

Constructed between 1972 and 1973, the Forbes Avenue Bridge over Fern Hollow in Pittsburgh, Pennsylvania, suffered a complete structural collapse on January 28, 2022. The Fern Hollow Bridge was a 442'-8" long rigid frame bridge consisting of three spans (138'-4" – 166'-0" – 138'-4") and fabricated from uncoated weathering steel. Investigation of the collapse by the National Transportation Safety Board (NTSB) is ongoing and **the probable cause of the failure has yet to be determined.**

On May 18, 2023, the NTSB issued an interim report and recommendation related to the Fern Hollow Bridge collapse titled "Improving the Identification, Prioritization, and Completion of Follow-up Actions on Bridges with Uncoated Weathering Steel Components" (NTSB/HIR-23-07). That report detailed three findings related to the condition of the legs of the Fern Hollow Bridge rigid frames, incomplete maintenance items on the Fern Hollow Bridge and other bridges in Pennsylvania, and the potential for corrosion and deterioration of uncoated weathering steel bridges associated with a lack of maintenance. The report made the following recommendation to the Federal Highway Administration (FHWA):

Develop a risk-based, data-driven process and encourage its use by state Departments of Transportation, as well as highway-bridge-owning federal agencies and tribal governments, to help them identify, prioritize, and perform follow-up actions documented in inspections of bridges with uncoated weathering steel components. (H-23-13)

In 1989, FHWA issued [Technical Advisory 5140.22](#) "Uncoated Weathering Steel in Structures" (TA5140.22) that provides guidelines for the proper application of uncoated weathering steel (UWS) and recommendations for maintenance to ensure continued successful performance of UWS bridges. The Fern Hollow Bridge was not located in a marine, high rainfall and humidity, or industrial environment where TA5140.22 recommended that owners exercise caution in using UWS. However, being constructed prior to the technical advisory, the bridge did incorporate deleterious design details, such as deck drainage that allowed runoff to flow onto to the legs and numerous debris traps,

that TA5140.22 later recommended that bridge owners avoid in order to eliminate conditions where excessive oxidation could occur in UWS bridge components and where corrosion could occur in both uncoated and coated steel. Lastly, regardless of the environmental and detailing considerations made in the design and fabrication of a UWS bridge, TA5140.22 urges owners to implement routine inspection and maintenance actions to ensure that UWS bridges remain safe and serviceable. The NTSB interim report noted that maintenance actions identified in inspection reports for the Fern Hollow Bridge during an 11-year period leading up to the collapse were not performed.

Four vehicle occupants were injured, two seriously, in the Fern Hollow Bridge collapse, and a National Highway System route was placed out of service for 11 months. As a result, to best ensure a similar event does not again occur elsewhere, pursuant to 23 CFR 650.313 and 650.315, the State DOTs shall take the following actions:

1. Identify all bridges in their inventory, regardless of ownership, with uncoated weathering steel components in the primary load path.
2. Categorize the identified bridges with uncoated weathering steel components into the following groups:
 - a. Group 1, including:
 - i. Bridges with uncoated weathering steel components in the substructure, or that are a rigid frame, and have a condition rating of 4 or less for the component (superstructure or substructure) containing the uncoated weathering steel element(s); and
 - ii. Bridges with uncoated weathering steel nonredundant steel tension members in the superstructure that have a superstructure condition rating of 4 or less; and
 - iii. Bridges on the National Highway System with any uncoated weathering steel National Bridge Element (except bridge railings) with quantities in Condition State 4.
 - b. Group 2: All bridges with uncoated weathering steel components not categorized into Group 1.
3. By October 31, 2023, report the National Bridge Inventory structure numbers of all bridges in Group 1 to FHWA.
4. By December 31, 2024, for each bridge in Group 1, perform the following actions:
 - a. Review inspection and maintenance records to confirm that bridge inspector-recommended or otherwise recommended work items have been completed that address deficiencies resulting from poor performance of uncoated weathering steel, and that the current load rating for the bridge adequately and appropriately considers the documented deterioration and any completed work.
 - b. Where completion of the recommended work items can be confirmed, but the load rating for the bridge does not adequately and appropriately consider the documented deterioration and completed work, update the load rating accordingly.
 - c. Where completion of the recommended work items has not occurred or cannot be confirmed:
 - i. Review the inspection records for the bridge to ensure that all deterioration of the uncoated weathering steel is documented in sufficient detail to support a

- load rating, and that the current load rating for the bridge adequately and appropriately considers the documented deterioration.
 - ii. Where the deterioration is sufficiently documented but the load rating for the bridge does not adequately and appropriately consider the documented deterioration, update the load rating accordingly.
 - iii. Where the inspection records do not show sufficient documentation, conduct an additional one-time special inspection to document the severity and extent of the deterioration, and update the load rating considering the documented deterioration.
 - d. Work with their FHWA Division Office to update the inventory data reported in paragraph 3 on a quarterly basis until all follow-up actions and documentation are completed, to include:
 - i. If completion of the work has been confirmed, the month and year when the bridge inspector-recommended or otherwise recommended work items addressing deficiencies resulting from poor uncoated weathering steel performance were completed in accordance with paragraph 4.a,
 - ii. If completion of the work has not been confirmed, the month and year when the extent of deterioration was documented in accordance with paragraph 4.c.
 - iii. The month and year when the bridge load rating was updated considering the severity and extent of the documented deterioration and any completed work.
5. For each bridge in Group 2:
- a. During the next scheduled inspection, confirm that all preventative maintenance or preservation activities necessary to ensure the satisfactory performance of the uncoated weathering steel, as described in Technical Advisory 5140.22, are identified and communicated to the appropriate authority.
 - b. Notify FHWA when this task is complete for all bridges in Group 2.

Attachment A includes a flow chart of the above requirements.

Please convey the important requirements of this memorandum to your respective State DOT to ensure they take the actions listed by the required deadlines. These actions are critical to maintaining safety and serviceability of bridges for the traveling public.

Should you or your staff have any questions, please contact Derek Soden at (202) 493-0341 or derek.soden@dot.gov, or Samantha Lubkin at (202) 366-1575 or samantha.lubkin@dot.gov.

Attachment

cc:

Hari Kalla, HIF-1

Directors of Field Services

Associate Administrator, Office of Innovation and Workforce Solutions

HIBS-10

HIBS-30

HIBS-40

Peter Stephanos, HISM-1

Brian Hogge, HICP-1

Attachment A Process Flow Chart

