2018 Routine/Fracture Critical Member Inspection Report

Charles Dana Bridge
NH Route 119 over the Connecticut River
NHDOT Bridge No. 042/044
Hinsdale, New Hampshire

July 2018

Prepared for:
New Hampshire Department of Transportation

Hoyle, Tanner & Associates, Inc.
www.hoyletanner.com

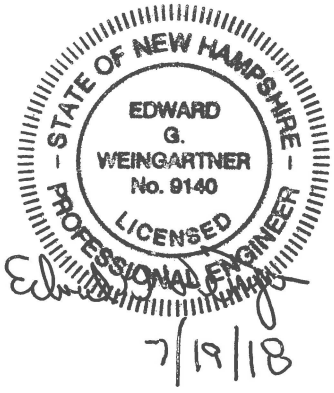
2018 Routine/Fracture Critical Member Inspection Report

Charles Dana Bridge
NH Route 119 over the Connecticut River
NHDOT Bridge No. 042/044
Hinsdale, NH

Prepared for

The Department of Transportation

July 2018

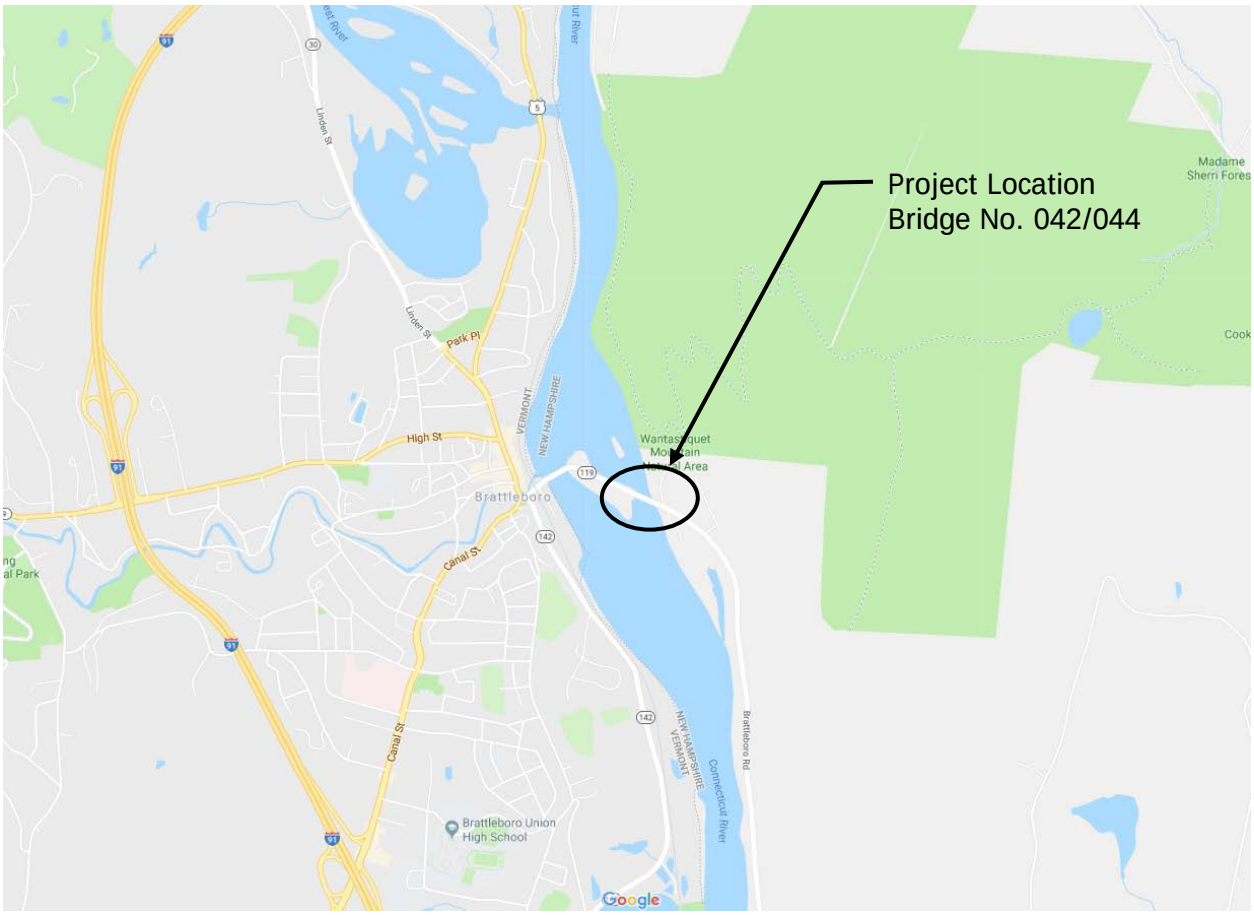


Prepared by

Hoyle, Tanner & Associates, Inc.
150 Dow Street
Manchester, New Hampshire 03101
603-669-5555
603-669-4168 fax
www.hoyletanner.com

TABLE OF CONTENTS

LOCATION MAP



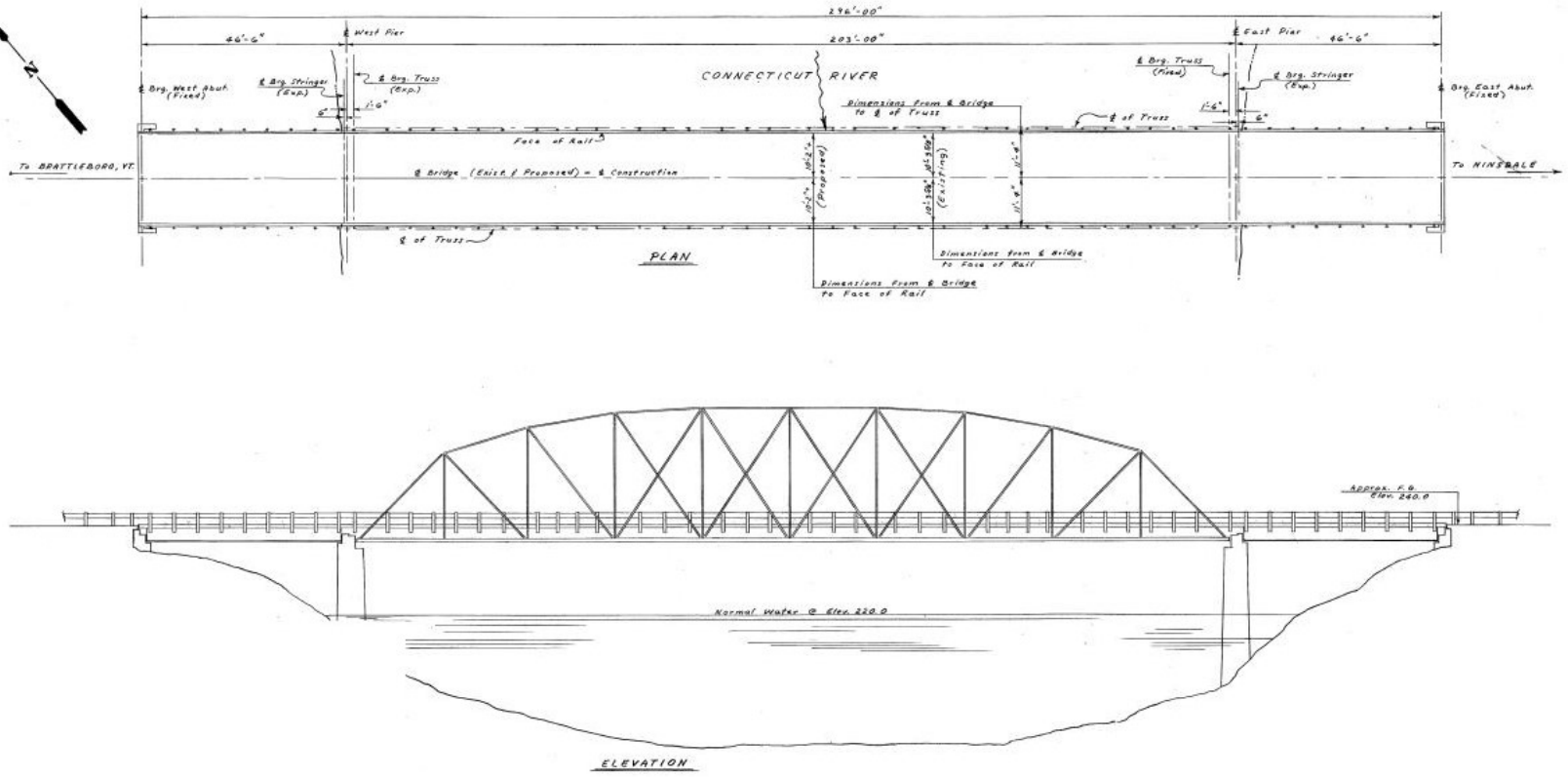
NH Route 119 over the Connecticut River Hinsdale, NH	Hoyle, Tanner & Associates, Inc.	**File Name:** N/A	
		DATE: 7/18	**Page 1**

DESCRIPTION OF BRIDGE

Date of Construction:	1927, Rehabilitated in 1988
Original Design Loading:	Trusses: H15; Deck, Stringers and Floorbeams: HS20
Bridge Type:	Steel Through Truss – Camelback
Skew:	None
Spans:	1
Width of Highway Bridge Deck:	20'-4 1/8" Between Face-of-Rails
Roadway Surface:	Precast Concrete Deck Panels (Variable Thickness) with an Epoxy Wearing Surface
Sidewalk/Walkway/ Median:	Timber decking
Bridge Railing:	Double Nested W-Beam Guardrail
Approach Railing:	W-Beam Guardrail
Superstructure:	Through truss comprised of riveted built-up upper chords, lower chords, vertical, and horizontal members; and diagonal members. The bridge deck is supported by rolled shape stringers. The stringers are supported by rolled shape floorbeams connected to the trusses at panel points.
Modifications to Original Superstructure:	The bridge deck was replaced in 2004 and the floor system (stringers and floorbeams) was replaced in their entirety in 1988. The bridge rail was replaced with double nested W-beam guardrail in 1988. A cantilevered sidewalk was added to the northerly truss in 1994.
Utilities:	Electric lines are attached to the truss and sway bracing to provide power for street lights on the bridge.
Substructure:	Reinforced concrete abutments and piers.
Modifications to Original Substructure:	None

BRIDGE PLAN AND ELEVATION

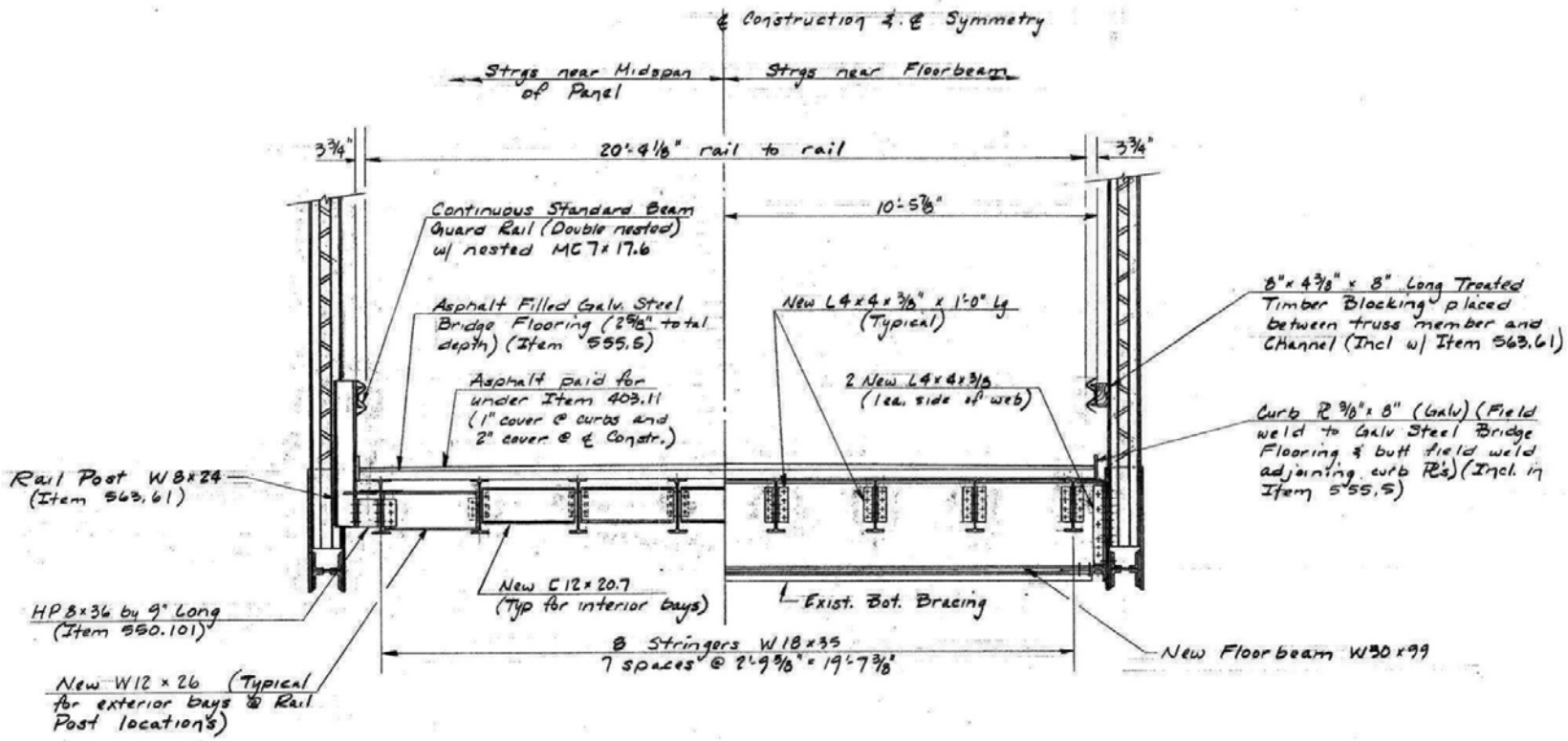
Note: Plan and elevation taken from "State of New Hampshire Department of Transportation Plans of Proposed N.H. Project No. 10603 N.H. 119 Over Connecticut River (2 Bridges) Bridge Rehabilitation" plans dated February 17, 1987.



Hoyle, Tanner & Associates, Inc.

TYPICAL BRIDGE SECTION

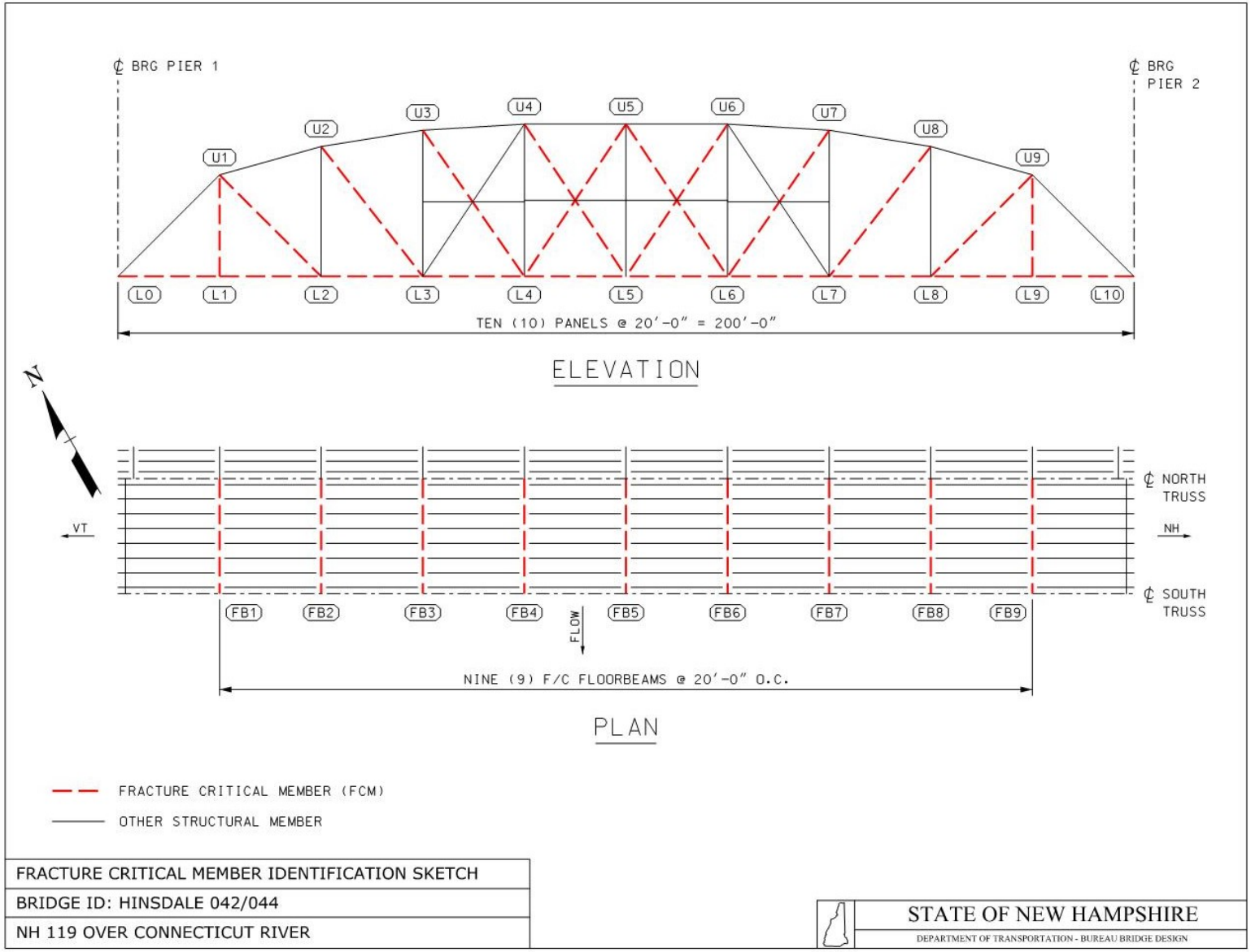
Note: Typical section taken from "State of New Hampshire Department of Transportation Plans of Proposed N.H. Project No. 10603 N.H. 119 Over Connecticut River (2 Bridges) Bridge Rehabilitation" plans dated February 17, 1987.



TYPICAL SECTION OF TRUSS SPAN WITH PROPOSED DECK SYSTEM

Hoyle, Tanner & Associates, Inc.

IDENTIFICATION OF FRACTURE CRITICAL MEMBERS



Hoyle, Tanner & Associates, Inc.

ROUTINE/FRACTURE CRITICAL MEMBER INSPECTION OVERVIEW

Introduction

Hoyle, Tanner and Associates, Inc. (Hoyle, Tanner) performed a routine/fracture critical member (FCM) inspection of the Charles Dana Bridge (NHDOT Br. No. 042/044) carrying NH Route 119 over the side channel of the Connecticut River in Hinsdale, NH for the New Hampshire Department of Transportation (NHDOT) from June 27 through June 29, 2018. The FCM inspection was performed for the following members:

- Floorbeams
- Lower Chords
  - L0-L1, L1-L2, L2-L3, L3-L4, L4-L5, L5-L6, L6-L7, L7-L8, L8-L9, L9-L10
- Diagonals
  - U1-L2, U2-L3, U3-L4, U4-L5, L4-U5, U5-L6, L5-U6, L6-U7, L7-U8, L8-U9
- Verticals
  - U1-L1, U9-L9

This inspection was limited to the truss span and the piers; therefore, condition information for the end span superstructure and abutments is not included in this report. Electric lines attached to the truss and sway bracing to provide power for street lights on the bridge constrained inspection access to the following north truss members and gusset plates:

- Truss members U4-M45, M45-U5, U5-M56 and M56-U6,
- Gusset plates U4, U5 and U6.

Bridge Description

The Charles Dana Bridge, constructed in 1927 and rehabilitated in 1988, carries NH Route 119 over the side channel of the Connecticut River from Hinsdale to Hinsdale Island. The bridge is comprised of two (2) Camelback through steel trusses spaced at 22'-8" and has a span length of 200'-0". Truss members consist of riveted built-up chords, verticals, diagonals and horizontals. The floor system consists of variable thickness precast concrete deck panels supported by eight (8) W18x35 stringer lines and W30x99 floorbeams at interior panel points. The bridge deck supports a 20'-4 1/8" roadway. A cantilevered sidewalk with a timber deck was added to the bridge in 1994.

The superstructure is supported by two (2) reinforced concrete piers.

Truss panel points and floorbeams are numbered from west to east with the western most panel point designated as 0. Stringers are numbered from north to south. The first number designates the truss panel number while the second number designates the stringer number (i.e. panel number 3 stringer 5 is denoted as stringer 35).

Routine/Fracture Critical Member Inspection Methods

The stringers, floorbeams, lower chords, lower lateral bracing and lower panel point gusset plates were inspected using an Aqualift inspection vessel operated from the river. The truss members (diagonals, verticals and upper and mid gusset plates) and upper lateral and sway bracing systems above the bridge deck were inspected using a JLG 45' articulating boom lift. One lane of alternating two-way traffic was maintained during the inspection of the truss members above the bridge deck.

BRIDGE CONDITION

Critical Findings Summary

There were no critical structural or hazard findings made during this inspection. However, Hoyle, Tanner recommends reducing the superstructure NBI rating from 5 fair to 4 poor due to the level of observed deterioration and section loss of the lower chord. Elements identified which require maintenance or repair are summarized in the Maintenance and Repair Recommendations section of this report.

Item 58 Deck

Item 58 Deck – Good Condition (NBI Condition Rating 7)

58.1 Deck:

The bridge deck is considered to be in good condition. The following deficiencies were observed and are summarized below:

- Fine cracking on soffit.
- Several precast concrete deck panel joint backer rods are protruding below soffit.
- Evidence of panel joint leakage.

58.2 Wearing Surface:

The epoxy overlay wearing surface is mainly intact but does have areas of potholing. Refer to Appendix A for representative condition photographs.

58.3 Bridge Rail:

The bridge rail is considered to be in good condition. The W-beam bridge rail exhibits galvanized coating damage with light rusting, minor scrapes and minor impact damage throughout. Damage is more significant at the rail approach ends. Refer to Appendix A for representative condition photographs.

Item 59 Superstructure

Item 59 Superstructure – Poor Condition (NBI Condition Rating 4)

Item 59.1 Stringers:

The stringers are considered to be in satisfactory to poor condition. The following deficiencies were observed and are summarized below:

- Interior stringers exhibit paint system failure with light to moderate top and bottom flange rusting with some laminar corrosion.
- Exterior stringers exhibit paint system failure with varying degrees of light, moderate and heavy top and bottom flange rusting.
- Exterior stringers exhibit varying degrees of minor to advanced laminar corrosion and section loss.
- Exterior stringer S41 has bottom flange remaining thicknesses of:
    - 0.19” at 24” from FB5,
    - 0.31” at midspan on the south face,
    - 0.40” at midspan on the north face.
- Exterior stringer S98 has a bottom flange remaining thicknesses of 0.30” at midspan.

Item 59.1 Floorbeams:

The floorbeams are considered to be in fair condition. The following deficiencies were observed and are summarized below:

- Paint system failure with top and bottom flange light to moderate rusting with scaling and laminar corrosion.
    - Some minor top flange section loss was observed at the ends.
- Scattered light to moderate web rusting with scaling.
- Floorbeam 4 exhibits approximately 50% and 20% bottom flange section loss at the north and south ends respectively.
- Floorbeam 5 exhibits approximately 50% and 25% south end bottom flange section loss at the east and west side of the web respectively.
- Floorbeam 9 has west flange thickness remaining of 0.59” to 0.64” located at approximately 5’ from the north end.
- Pack rust with prying and some section loss between floorbeam and lower lateral bracing gusset plates.

Refer to Appendix A for representative condition photographs.

Item 59.2 Truss Members:

The lower chord angle legs and side plates general exhibit paint system failure with moderate to heavy rusting throughout. The lower chords are considered to be in poor condition based on the level of observed deterioration and section loss. The following deficiencies were observed and are summarized below:

- Significant pack rust with prying up to 1¼" thick is present between the angle horizontal legs throughout the lower chord.
- The lower chord tie plates exhibit advanced section loss of up to 100%, knife-edging and rivet head losses of up to 100% throughout.
- Lower chord tie plate member rivet head section loss of up to 90% was observed at isolated locations throughout.
- The angle horizontal legs have significant laminar corrosion and exhibit varying degrees of section loss throughout the lower chord.
  - Laminar corrosion and pack rust between the horizontal legs of the lower chord with section loss resulting in remaining horizontal leg width of approximately 2½" to 3" was generally observed throughout the lower chord.
  - South truss member L0-L1 north element angle horizontal leg remaining thickness is 0.38".
  - North truss member L2-L3 has an angle horizontal leg remaining thickness ranging from 0.15" to 0.21".
  - South truss member L6-L7 north element angle horizontal leg remaining thickness ranging from 0.19" to 0.30".
  - Other lower chord members not measured and previously noted are considered to have a remaining horizontal leg thickness of approximately ¼" based on the level of pack rust, laminar corrosion, deterioration and section loss observed.
- South truss members L0-L1 and L1-L2 bottom vertical leg at the L1 north gusset plate interface exhibits approximately 50% section loss for 2¾" vertically and 2½" horizontally on both sides of the gusset.
- North truss member L1-L2 north element lower angle vertical leg has 0.31" remaining thickness in an area 3" high by 12" long.
- North truss member L3-L4 south element lower angle vertical leg exhibits laminar corrosion with approximately 1/8" section loss.
- North truss member L4-L5 has a 2" by 2" by ¼" deep pit on the south face of the north element near L5.
- South truss member L5-L6 north element exhibits heavy rusting with laminar corrosion on its north face.
- South truss member L7-L8 north element side plate has 50-100% loss for 4½" vertically by 7" horizontally on the top of the side plate and 100% loss for 3" vertically and 6" horizontally on the bottom of the side plate.
- South truss member L6-L7/L7-L8 north element at L7 has lower angle vertical leg loss of ½".
- North truss member L8-L9 south element side plate has 100% loss for 1" vertically and 2" horizontally on the bottom of the side plate in two locations.
- South truss member L9-L10 north element lower angle vertical leg has a 2½" high by 3" long area of 100% section loss at a distance of 1'-3" from the edge of the L10 gusset

plate. Remaining vertical leg exhibits 1/16" section loss. The horizontal leg remaining thickness ranging from 0.42" to 0.56".

- North truss member L9-L10 south lower angle leg has a remaining thickness of 0.40".
- Pack rust up to ½" thick between the angle vertical legs and the side plates.
- Chord splice plates exhibit heavy rusting with laminar corrosion and advanced section loss and rivet head loss.
  - Advanced deterioration and section losses are primarily located on the south truss members.
  - South truss south lower interior splice bar at L4 exhibits significant rusting with laminar corrosion and section loss. The lower 2½" of the splice bar is 100% lost at the splice and remaining section has approximately 50% of thickness loss. See photos 14 and 15.
  - South truss south upper splice bar at L6 has a 24" wide by up to 3" high with 3/8" to ¼" deep pitting/section loss.
  - Splice plate rivet head losses of up to 100% were observed.

The truss upper chords exhibit paint system failure with light to moderate rusting on the interior and exterior surface. These members are considered to be in satisfactory condition.

The truss diagonals are considered to be in satisfactory condition. The truss diagonals exhibit paint system failure with light to moderate surface rusting. The following deficiencies were observed and are summarized below:

- Pack rust between member angles varies from ½" to ¾" thick.
- Some diagonal members exhibit rust blooms with up to 1/16" deep pitting.
- North truss diagonal member M34-L4 and M45-L5 south elements have up to 1/8" section loss on angle top legs.
- North truss diagonal members L5-M56, and L6-M67 exhibit rivet head loss up to 50%.
- North truss diagonal members M45-L5, and M56-L6 exhibit rivet head loss up to 75% at the first tie plate adjacent to L5 and L6 respectively.
- South truss member U2-L3 north face has a 1½" diameter of 1/8" section loss located 3'-8" above the bridge deck.
- North truss diagonal member M67-L7 has up to 1/16" section loss on angle top legs.
- Gouges, scrapes, abrasions and damage from impact were also observed, including the following specific locations:
  - South truss member U1-L2 has minor scraping on the roadway side located 5'-0" above the bridge deck.
  - South truss member U2-L3 is bent up to 1/8" out-of-plane upward near the bridge rail.
  - South truss member L3-M34 north element member bent out of plane (globally).
  - North truss member L4-M45 has a slight gouge.
  - North truss member M56-L6 is bent and twisted toward the center of the bridge.
  - North truss member L8-U9 south element has three ½" long by 3/8" high gouges located 3'-6" above deck.

- North truss member L8-U9 south element angle leg is bent ½" out-of-plane at 7'-6" above the deck.

The end diagonals are considered to be in satisfactory condition. The member exterior surfaces exhibit paint system failure with light to moderate surface rusting. The end diagonals also exhibit areas of minor impact damage. The end diagonal interior surfaces and lacing bars generally exhibit paint system failure with varying degrees of light to heavy surface rusting, laminar corrosion and section loss. Lacing bars have up to 100% section loss. Rivet heads exhibit up to 50% section loss.

The truss vertical members are considered to be in satisfactory condition. These members exhibit paint system failure with light to moderate surface rusting. Holes in members used to connect the original bridge rail are unfilled. Some members exhibit pack rust between member angles. Vertical member lacing bars exhibit advanced section loss with several having up to 100%. South truss member U2-L2 exhibits 2½" by 2½" area of 100% north element west angle leg section loss below deck level. This member also exhibits up to 100% rivet head section loss. North truss member U7-L7 has minor impact damage below the bridge rail with the angle leg bent ¾" out of plane for a length of 15". North truss member U9-L9 has 1/16" section loss at the interface with the bridge rail timber offset block. This member also has minor impact damage with the south element angle leg bent 3/8" out of plane for a length of 6" located 7'-6" above the bridge deck. This member also has minor section loss of the lacing bars in the spray zone. South truss member U9-L9 exhibits lacing bar section loss of up to 1/8".

Truss mid-height horizontal members are considered to be in good condition. No significant deficiencies were observed. However, the member exhibit paint system failure with minor surface rust.

Refer to Appendix A for representative condition photographs.

Item 59.4 Lateral and Sway Bracing:

Upper Lateral Bracing:

Upper lateral bracing members are considered to be in good condition. The upper lateral bracing exhibits areas of paint system failure with light to moderate surface rust.

Lower Lateral Bracing:

The lower lateral bracing exhibits varying degrees of light to heavy rusting with laminar corrosion and section loss. Some members are bowed due to their alignment with connection plates and mid-panel connection plates. These members are considered to be in fair condition.

Portal Bracing:

The portal bracing exhibits paint system failure with light to moderate rusting on members. Pack rust between bracing members and gusset plates is also present. The portal bracing also exhibits impact damage. These members are considered to be in satisfactory condition.

Sway Bracing:

The sway bracing bottom struts exhibit varying degrees of damage due to vehicular impact. The severity of damage ranges from scrapes of the paint, up to deformation of the steel members. There are areas of paint system failure with light to moderate surface rust and the pack rust between components of built-up members throughout. The sway bracing members are considered to be in satisfactory condition.

Refer to Appendix A for representative condition photographs.

Item 59.5 Connections and Plates

The upper and mid-panel gusset plates exhibit paint system failure with light to moderate surface rusting and are considered to be in satisfactory condition. Mid-panel gusset plates exhibit pack rust with prying between the gusset plate and member varying in thickness up to 1/8" thick. South truss U3 and U5 north gusset plates have surface imperfections (divots and/or deformed surfaces) near rivet heads and appear to have been caused during construction of the bridge. Gusset plates U6, U7, U8 and U9 exhibit minor pitting throughout.

The lower gusset plates are considered to be in fair to poor condition. The following deficiencies were observed and are summarized below:

- Lower gusset plates exhibit paint system failure with moderate to heavy surface rusting with laminar corrosion and section loss.
- Areas of advanced pitting ranging from 1/8" to 3/16" in depth.
- Laminar corrosion and section losses up to 1/8" at the lower lateral bracing interface.
- Pack rust with prying up to ¾" thick between truss members and gusset plates.
- Gusset plates generally exhibit varying degrees of rivet head losses.
  - North truss L2 gusset plates exhibit rivet head section loss ranging from 30% to 80% for member U1-L2.
  - South truss gusset plate L4 north plate exhibits up to 50% rivet head loss.
  - South truss gusset plate L5 north plate exhibits up to 90% rivet head loss in the lower chord connection.
  - North truss gusset plate L5 south plate exhibits up to 90% rivet head loss for member L5-M56.
  - South truss gusset plate L6 north plate exhibits up to 50% rivet head loss.
  - North truss gusset plate L6 south plate exhibits up to 75% rivet head loss.
  - North truss gusset plate L7 south plate exhibits up to 80% rivet head loss for member L7-U8.
- Missing rivets/bolts were observed at the following locations:
  - North truss gusset plate L1 north plate has one missing rivet/bolt.

  - South truss gusset plate L6 north plate has one unfilled rivet hole in the lower chord connection. Lower chord does not have the corresponding hole.
  - South truss gusset plate L8 north plate has one missing rivet in the lower chord connection.
- North truss gusset plate L0 south plate is knife-edged at the free edge below the lower chord.
- South truss gusset plate L3 south plate is knife-edged for a length of 3" at the free edge below the lower chord. The north plate exhibits 100% section loss and knife edging at the free edge below the lower chord for a horizontal length of 12".
- North truss L3 gusset plate exhibits rusting with laminar corrosion and section loss up to 1/8".
- North truss gusset plate L4 south plate exhibits areas of section loss and has a remaining thickness of 0.33".
- North truss gusset plate L6 south plate has 1" vertical section loss and knife edging for 8" horizontally on the bottom directly below vertical member U6-L6.
- South truss gusset plate L10 south plate exhibits up to 100% section loss for a height of 3" and length of 1'-3" at the free edge below the lower chord near the bearing.
- North truss gusset plate L10 north plate exhibits up to 50% section loss at the free edge below the lower chord near the bearing.

The lower lateral bracing system connection plates are considered to be in fair to poor condition. The bracing connection plates exhibit paint system failure with moderate to heavy rusting with laminar corrosion and section losses of up to 100%. Pack rust exists between the lower lateral bracing connection plates and the floorbeam bottom flanges.

The stringer to floorbeam connection angles are considered to be in satisfactory condition. Stringer connections exhibit paint system failure with varying degrees of light, moderate and heavy rusting and laminar corrosion.

The floorbeam to truss connection angles exhibit paint system failure with light to moderate surface rusting and are considered to be satisfactory condition. Pack rust with prying was observed at the lower portion of the angles near the lateral bracing connection angles.

Refer to Appendix A for representative condition photographs.

Item 59.6 Cantilevered Sidewalk Support Members:

The cantilevered sidewalk support members generally exhibit paint system failure with varying degrees of light to heavy rusting with laminar corrosion and section loss. Rolled shape stringers exhibit advanced deterioration with up to 50% flange section loss. Refer to Appendix A for representative condition photographs.

Item 59.7 Bearings:

The bearings are considered to be in satisfactory to poor condition. The expansion and fixed shoes exhibit paint system failure with moderate to heavy rusting. There is heavy rusting with laminar corrosion of the pins and bearing saddles. Refer to Appendix A for representative condition photographs.

Item 60 Substructure

Item 60 Substructure – Fair Condition (NBI Condition Rating 5)

Item 60.1 Abutments:

The abutments were not included in this inspection.

Item 60.2 Piers:

The piers are considered to be in fair to poor condition. Accessible areas were sounded with a hammer to identify areas of delaminated concrete. The exposed timber cribbing under the east pier condition could not be evaluated due to the river water level. The following deficiencies were observed and are summarized below:

- The piers exhibit random areas of map cracking and spalling.
- The piers exhibit abrasion with exposed aggregate below the water surface.
- East pier cap west face repair concrete is delaminated.
- The east pier south column west face has a large spall with exposed and corroded reinforcement.

FRACTURE CRITICAL INSPECTION

Fracture Critical Members (FCM) and Fatigue Prone Detail Identification

Type of FCM:	Quantity Inspected:
Steel Riveted Truss Lower Chords	20
Steel Riveted Truss Diagonals	20
Steel Riveted Truss Verticals	4
Rolled Shape Floorbeams	9

Fracture Critical Member Inspection Procedures and Findings

1. Check all fasteners to determine if they are tight. Check for cracked or missing rivets and rivet heads.

   Findings: Although rivet head and tie plate significant section loss was observed in numerous locations, all are functioning as intended.

2. Check each component to see that the loads are being evenly distributed between them by attempting to vibrate the member by hand, and that tie plates are tight.

   Findings: All individual components are operating as one.

3. Check carefully along the first row of rivets/bolts for cracking as the first row carries more load than succeeding rows. The first row is the row closest to the edge of the gusset plate and perpendicular to the axis of the member.

   Findings: No cracks were observed.

4. Check for nicks, gouges and tears due to the impact from passing vehicular or marine traffic. This type of damage can initiate future cracks.

   Findings: North truss member L4-M45 has a slight gouge. North truss member L8-U9 south element has three ½" long by 3/8" high gouges located 3'-6" above deck. No cracking was observed at these locations.

5. Carefully observe any tack welding used either in construction or repair as this is a potential source of cracks. Tack welds should be flagged to the attention of the bridge engineer in the report for future observation and consideration in stress rating.

   Findings: No tack welds were found.

6. If any misplaced holes or holes used for construction have been plug welded, check carefully for fatigue cracks.

   Findings: No holes filled with plug welds were found.

7. Check area around stringer-to-floorbeam connections for cracking in the web due to out of plane bending.

   Findings: No cracks in the webs were found.

8. Check entire length of tension flanges and web for cracking which may have originated from corrosion, pitting, section loss, or defects in fabrication (i.e. nicks and gouges in the steel).

   Findings: There is corrosion, pitting, and section loss on the truss chord, diagonal, and vertical tension elements; however, no cracks propagating from corrosion were found.

Identification of Fatigue Sensitive Details (FSD)

FSD 21 – Base metal at net section of riveted and high strength bolted connections:

All fracture critical members

Quantity of FSD Types: 1

IDENTIFICATION OF FATIGUE SENSITIVE DETAILS (FSD)

General Condition	Situation	Detail Category	Illustrative Example; See Figure 6.6.1.2.3-1
Plain Members	Base metal:		1, 2
	• With rolled or cleaned surfaces; flame-cut edges with *AASHTO/AWS D1.5M/D1.5* (Section 3.2.2) smoothness of 1,000 μ-in. or less	A	
	• Of unpainted weathering steel, all grades, designed and detailed in accordance with FHWA (*1989*)	B	
	• At net section of eyebar heads and pin plates	E	
Builtup Members	Base metal and weld metal in components, without attachments, connected by:		3, 4, 5, 7
	• Continuous full-penetration groove welds with backing bars removed, or	B	
	• Continuous fillet welds parallel to the direction of applied stress	B	
	• Continuous full-penetration groove welds with backing bars in place, or	B′	
	• Continuous partial-penetration groove welds parallel to the direction of applied stress	B′	
	Base metal at ends of partial-length cover plates:		
	• With bolted slip-critical end connections	B	22
	• Narrower than the flange, with or without end welds, or wider than the flange with end welds		7
	○ flange thickness ≤0.8 in.	E	
	○ flange thickness >0.8 in.	E′	
	• Wider than the flange without end welds	E′	
Groove-Welded Splice Connections with Weld Soundness Established by NDT and All Required Grinding in the Direction of the Applied Stresses	Base metal and weld metal at full-penetration groove-welded splices:		
	• Of plates of similar cross-sections with welds ground flush	B	8, 10
	• With 2.0 ft. radius transitions in width with welds ground flush	B	13
	• With transitions in width or thickness with welds ground to provide slopes no steeper than 1.0 to 2.5		11, 12
	○ grades 100/100W base metal	B′	
	○ other base metal grades	B	
	• With or without transitions having slopes no greater than 1.0 to 2.5 when weld reinforcement is not removed	C	8, 10, 11, 12

From AASHTO LRFD Bridge Design Specifications, 4th Edition, Table 6.6.1.2.3-1

IDENTIFICATION OF FATIGUE SENSITIVE DETAILS (FSD)

General Condition	Situation	Detail Category	Illustrative Example; See Figure 6.6.1.2.3-1
Longitudinally Loaded Groove-Welded Attachments	Base metal at details attached by full- or partial-penetration groove welds:		
	• When the detail length in the direction of applied stress is:		
	○ less than 2.0 in.	C	6, 15
	○ between 2.0 in. and 12 times the detail thickness, but less than 4.0 in.	D	15
	○ greater than either 12 times the detail thickness or 4.0 in.		
	—detail thickness <1.0 in.	E	15
	—detail thickness ≥1.0 in.	E′	15
	• With a transition radius with the end welds ground smooth, regardless of detail length:		16
	○ transition radius ≥24.0 in.	B	
	○ 24.0 in. > transition radius ≥ 6.0 in.	C	
	○ 6.0 in. > transition radius ≥ 2.0 in.	D	
	○ transition radius <2.0 in.	E	
	• With a transition radius with end welds not ground smooth	E	16
Transversely Loaded Groove-Welded Attachments with Weld Soundness Established by NDT and All Required grinding Transverse to the Direction of Stress	Base metal at detail attached by full-penetration groove welds with a transition radius:		16
	• With equal plate thickness and weld reinforcement removed:		
	○ transition radius ≥24.0 in.	B	
	○ 24.0 in. > transition radius ≥ 6.0 in.	C	
	○ 6.0 in. > transition radius ≥ 2.0 in.	D	
	○ transition radius <2.0 in.	E	
	• With equal plate thickness and weld reinforcement not removed:		
	○ transition radius ≥6.0 in.	C	
	○ 6.0 in. > transition radius ≥ 2.0 in.	D	
	○ transition radius <2.0 in.	E	
	• With unequal plate thickness and weld reinforcement removed:		
	○ transition radius ≥2.0 in.	D	
	○ transition radius <2.0 in.	E	
	• For any transition radius with unequal plate thickness and weld reinforcement not removed	E	
Fillet-Welded Connections with Welds Normal to the Direction of Stress	Base metal:		
	• At details other than transverse stiffener-to-flange or transverse stiffener-to-web connections	Lesser of C or Eq. 6.6.1.2.5-3	14
	• At the toe of transverse stiffener-to-flange and transverse stiffener-to-web welds	C′	6
Fillet-Welded Connections with Welds Normal and/or Parallel to the Direction of Stress	Shear stress on the weld throat Base metal at end of weld	E	9

From AASHTO LRFD Bridge Design Specifications, 4th Edition, Table 6.6.1.2.3-1

IDENTIFICATION OF FATIGUE SENSITIVE DETAILS (FSD)

General Condition	Situation	Detail Category	Illustrative Example; See Figure 6.6.1.2.3-1
Longitudinally Loaded Fillet-Welded Attachments	Base metal at details attached by fillet welds:		
	• When the detail length in the direction of applied stress is:		
	○ less than 2.0 in. or stud-type shear connectors	C	15, 17, 18, 20
	○ between 2.0 in. and 12 times the detail thickness, but less than 4.0 in.	D	15, 17
	○ greater than either 12 times the detail thickness or 4.0 in.		7, 9, 15, 17
	—detail thickness <1.0 in.	E	
	—detail thickness ≥1.0 in.	E′	
	• With a transition radius with the end welds ground smooth, regardless of detail length		16
	○ transition radius ≥2.0 in.	D	
	○ transition radius <2.0 in.	E	
	• With a transition radius with end welds not ground smooth	E	16
Transversely Loaded Fillet-Welded Attachments with Welds Parallel to the Direction of Primary Stress	Base metal at details attached by fillet welds:		16
	• With a transition radius with end welds ground smooth:		
	○ transition radius ≥2.0 in.	D	
	○ transition radius <2.0 in.	E	
	• With any transition radius with end welds not ground smooth	E	
Mechanically Fastened Connections	Base metal:		21
	• At gross section of high-strength bolted slip-critical connections, except axially loaded joints in which out-of-plane bending is induced in connected materials	B	
	• At net section of high-strength bolted nonslip-critical connections	B	
	• At net section of riveted connections	D	
Eyebar or Pin Plates	Base metal at the net section of eyebar head, or pin plate	E	23, 24
	Base metal in the shank of eyebars, or through the gross section of pin plates with:		
	• Rolled or smoothly ground surfaces	A	23, 24
	• Flame-cut edges	B	23, 24

From AASHTO LRFD Bridge Design Specifications, 4th Edition, Table 6.6.1.2.3-1

IDENTIFICATION OF FATIGUE SENSITIVE DETAILS (FSD)

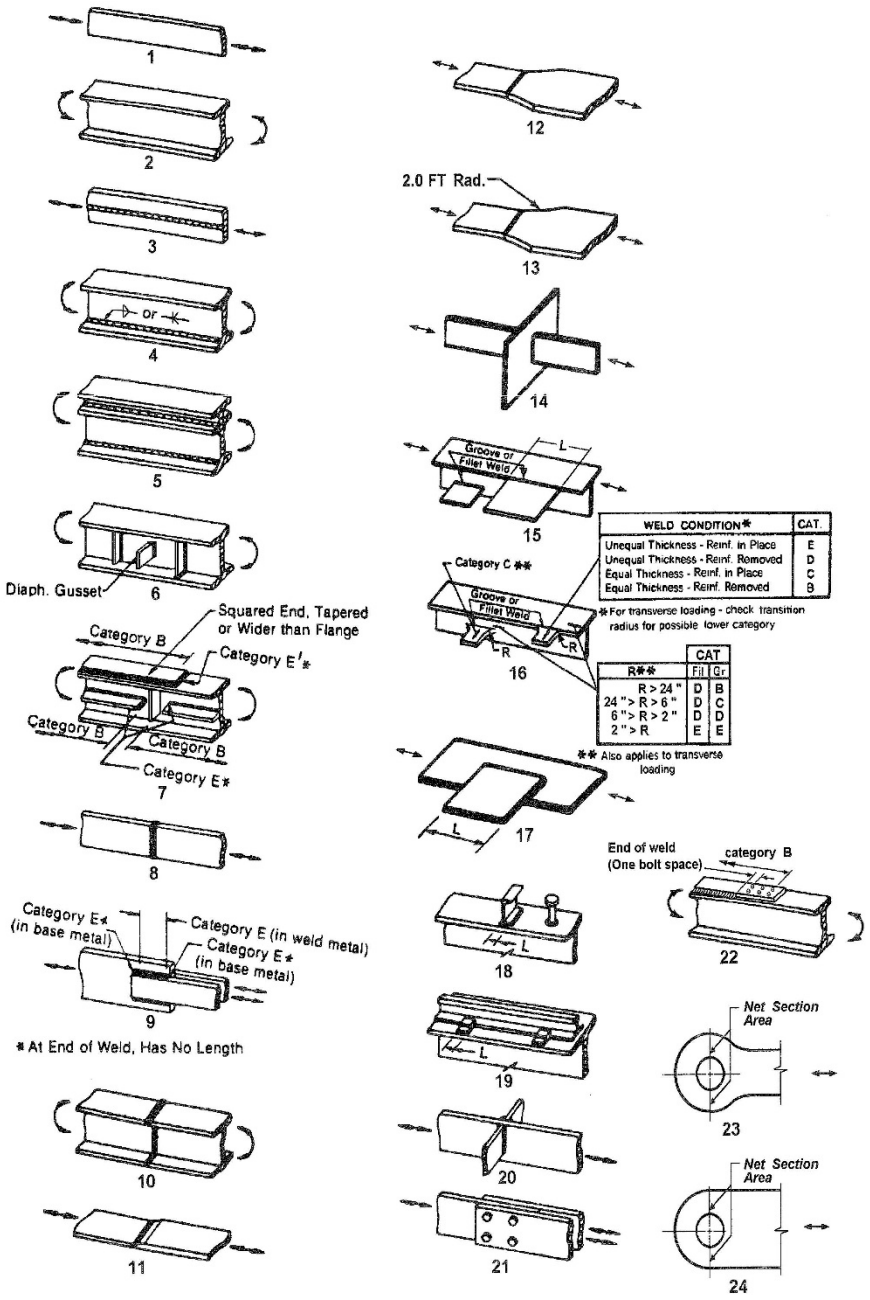


Figure 6.6.1.2.3-1 Illustrative Examples.

From AASHTO LRFD Bridge Design Specifications, 4th Edition, Table 6.6.1.2.3-1

MAINTENANCE AND REPAIR RECOMMENDATIONS

Based on the inspection observations, the maintenance and repair recommendations are categorized as immediate, short-term, and long-term.

Immediate (0 to 3 Months):

Hoyle, Tanner recommends the south truss splice at L4 be analyzed due the level of corrosion and section loss and repaired/strengthened if necessary to maintain the current E2 weight limit posting. The south truss splice at L6 should be cleaned of all rust and corrosion and then evaluated/analyzed to determine if repairs are required.

Hoyle, Tanner also recommends that accumulated debris be removed from the lower chords, floorbeams and lateral bracing gusset plates.

Short-term (3 to 24 Months):

None.

Long-term (Beyond 24 Months):

Hoyle, Tanner recommends consideration be given to replacing the bent and twisted diagonal members, lower chords, lower lateral bracing system and all exterior stringers as part of a future rehabilitation project due to the level of damage, pack rust, deterioration and section loss observed. Lower gusset plates should be evaluated for continued use in the rehabilitated structure.

APPENDIX A

Inspection Photos

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 1

Location:

Bridge deck

Description:

Wearing surface potholes.

PHOTO NO. 2

Location:

W-beam bridge rail

Description:

Typical condition.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 3

Location:

North truss L1 north gusset plate, north face

Description:

Typical gusset plate pack rust and laminar corrosion.

PHOTO NO. 4

Location:

North truss L0 north gusset plate north face

Description:

Section loss.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 5

Location:

North truss L0, south gusset plate north face

Description:

Section loss and knife edge.

PHOTO NO. 6

Location:

South truss L2 south gusset plate, south face

Description:

Typical gusset plate condition.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 7

Location:

South truss lower chords at L2, south element, north face

Description:

Lower chord member knife edge and section loss.

PHOTO NO. 8

Location:

South truss L2 north gusset plate, south face

Description:

Typical gusset plate laminar corrosion.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 9

Location:

North truss L2 north gusset plate, north face

Description:

Typical gusset laminar corrosion and rivet head section loss.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

PHOTO NO. 10

Location:

South truss L10 south gusset plate, south face

Description:

Section loss along bottom of plate.

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 11

Location:

South truss member L9-L10, north element, north face

Description:

Bottom angle vertical leg section loss.

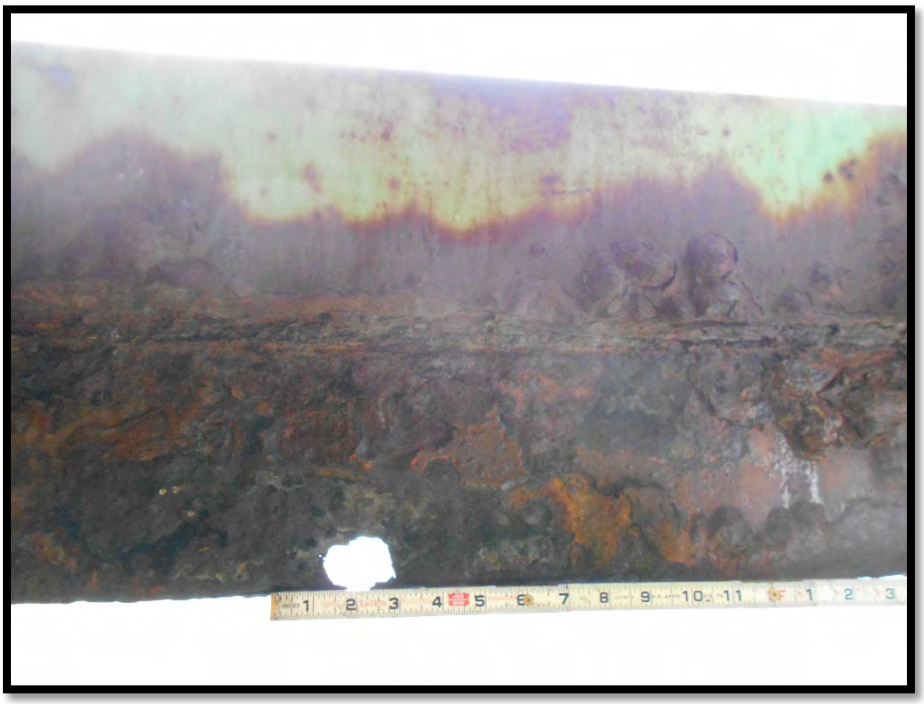


PHOTO NO. 12

Location:

North truss member L3-L4

Description:

Typical lower chord condition.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 13

Location:

North truss member L7-L8

Description:

Typical lower chord pack rust and member section loss.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

PHOTO NO. 14

Location:

South truss lower chord splice at L4, south gusset plate, north face

Description:

Splice plate section loss.

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 15

Location:

South truss lower chord splice at L4, south gusset plate, north face

Description:

Splice plate section loss.

PHOTO NO. 16

Location:

South truss lower chord splice at L6 north gusset plate, south face

Description:

Section loss.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 17

Location:

South truss member L6-L7 north element, south face

Description:

Typical pack rust and lower chord section loss.

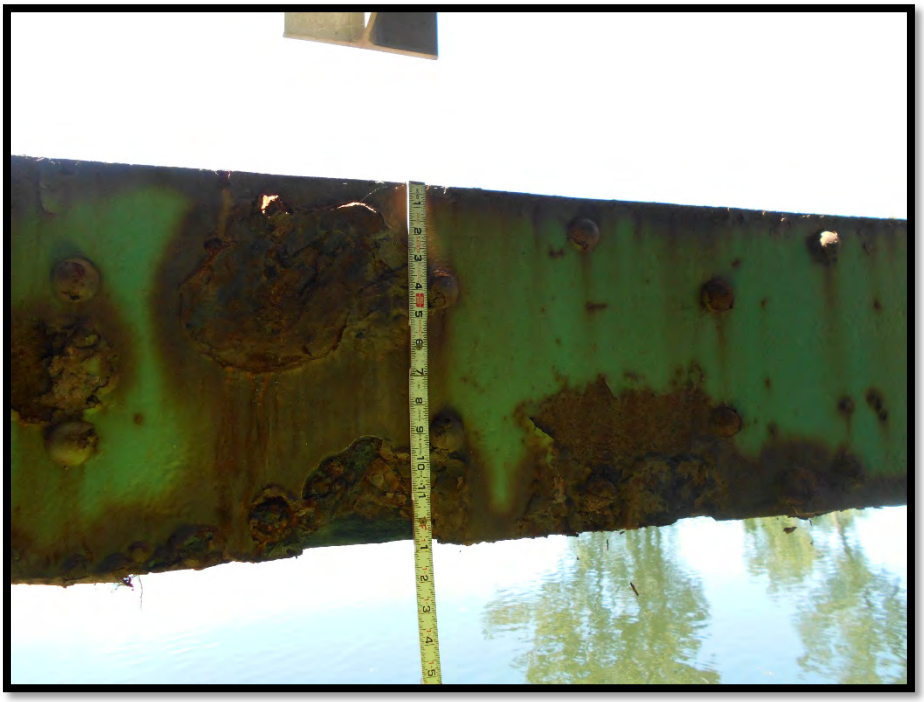
PHOTO NO. 18

Location:

South truss member L9-L10 north element, north face

Description:

Side plate section loss.



ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 19

Location:

North truss member L4-M45 north element

Description:

Little gouge in heel.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

PHOTO NO. 20

Location:

South truss member L7-U8: south element

Description:

Pack rust between angles above tie plate at L7 gusset plate, 9" long, up to 3/4" at toe.

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 21

Location:

North truss member L8-U9

Description:

South element bottom flange bent ½" to north, 1' long, 7.5' above top of deck.

PHOTO NO. 22

Location:

North truss member L8-U9

Description:

South element bottom flange bent ½" to north, 1' long, 7.5' above top of deck.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 23

Location:

North truss, L9-U9: south element

Description:

East flange bent 3/8” to north, 6” long, 7.5’ above top of deck.

PHOTO NO. 24

Location:

North truss member M45-L5 south element

Description:

Section loss up to 1/8" on top of heel above first tie plate from L5 gusset plate.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 25

Location:

North truss member M56-L6

Description:

Member bent and twisted toward centerline of bridge.

PHOTO NO. 26

Location:

North truss member U9-L10

Description:

Member impact damage.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 27

Location:

End diagonal

Description:

Typical condition.

PHOTO NO. 28

Location:

South truss member U2-L2

Description:

Section loss.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 29

Location:

Panel Point 3

Description:

Impact damage.

PHOTO NO. 30

Location:

Cantilevered sidewalk support system

Description:

Typical condition.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 31

Location:

East pier south truss bearing

Description:

Heavy rusting.

PHOTO NO. 32

Location:

West pier north truss bearing

Description:

Heavy rusting.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 33

Location:

West pier south column

Description:

Abrasion with exposed aggregate below water surface.

PHOTO NO. 34

Location:

East pier west face

Description:

Map cracking and spalling.

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

BRIDGE INSPECTION PHOTOGRAPHS **CHARLES DANA BRIDGE**

PHOTO NO. 35

Location:

East pier south column west face

Description:

Concrete spall with exposed reinforcement.

PHOTO NO.

Location:

Description:

ASSISTANT TEAM LEADER: Ross S. Wood, PE
FEATURE CROSSED: Connecticut River

TEAM LEADER: Edward G. Weingartner, PE
FEATURE CARRIED: NH Route 119

Hoyle, Tanner & Associates, Inc.

CORPORATE HEADQUARTERS

150 Dow Street
Manchester, NH 03101

BRANCH OFFICES

Pease International Tradeport
100 International Drive, Suite 360
Portsmouth, NH 03801

50 High Street, 4th Floor, Suite 49
North Andover, MA 01845

106 Lafayette Street, Unit 2D
Yarmouth, ME 04096

125 College Street, 4th Floor
Burlington, VT 05401

95 E. Mitchell Hammock Road, Suite 200
Oviedo, FL 32765