

AASHTO Guide Manual for Bridge Element Inspection

First Edition • 2011



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FOREWORD

This Manual is intended as a resource for agencies performing element level bridge inspections. It replaces the AASHTO Guide to Commonly Recognized Structural Elements (1994) and its interims as a reference for standardized element definitions, element quantity calculations, condition state definitions, element feasible actions, and inspection conventions.

AASHTO would like to recognize the dedication and tireless efforts of Michael B. Johnson of the California Department of Transportation and Paul Jensen of the Montana Department of Transportation in writing this manual.

AASHTO would also like to thank the following Steering Committee members for their support and guidance in developing this manual:

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CONTENTS

AASHTO Executive Committee 2010–2011	iii
AASHTO Highways Subcommittee on Bridges and Structures, 2010.....	iv
Foreword	v
Introduction.....	ix
Section 1—Background	1-1
1.1—Condition Assessment Philosophy: Multi-Path And Defect Concepts	1-1
1.2—National Bridge Elements (NBEs).....	1-1
1.3—Bridge Management Elements (BMEs).....	1-1
1.4—Agency Developed Elements.....	1-1
1.5—How to Use This Manual	1-2
Section 2—Element Location Matrix.....	2-1
2.1—National Bridge Elements.....	2-1
2.1.1—Decks/Slabs	2-1
2.1.2—Superstructure	2-2
2.1.3—Substructure	2-2
2.2—Bridge Management Elements.....	2-3
2.2.1—Decks/Slabs	2-3
2.2.2—Wearing Surfaces and Protection Systems	2-3
2.2.3—Smart Flags (Defect Flags).....	2-4
Section 3—Detailed Element Descriptions	3-1
3.1—National Bridge Elements.....	3-1
3.1.1—Decks/Slabs	3-1
3.1.2—Superstructure.....	3-9
3.1.2.1—Girders.....	3-9
3.1.2.2—Stringers	3-19
3.1.2.3—Trusses/Arches	3-25
3.1.2.4—Floor Beams	3-35
3.1.2.5—Miscellaneous Superstructure Elements.....	3-41
3.1.3—Substructure Elements.....	3-47
3.1.3.1—Columns/Pile/Pier Wall	3-47
3.1.3.2—Abutments	3-65
3.1.3.3—Submerged Pile/Caps/Footings	3-73
3.1.4—Culverts.....	3-87
3.1.5—Bearings.....	3-95
3.1.6—Bridge Rail.....	3-103

3.2—Bridge Management Elements.....	3-111
3.2.1—Joints.....	3-111
3.2.2—Approach Slabs.....	3-119
3.2.3—Smart Flags (Defect Flags).....	3-123
3.2.4—Protective Systems.....	3-125
3.2.5—Environmental Factors (States)	3-131
Appendix A—Agency Developed Elements	A-1
A.1—Agency Defined Subsets of the National Bridge Elements	A-1
A.2—Agency Defined Subsets of the Bridge Management Elements	A-1
A.3—Agency Developed Elements.....	A-2
Appendix B—Inspection Examples.....	B-1
B.1—Timber Bridge	B-1
B.2—Two Span Concrete AASHTO Girder Structure	B-3
B.3—Painted Steel Truss	B-6
Appendix C—Element Grouping	C-1
C.1—National Bridge Elements (NBE)	C-3
C.2—Bridge Management Elements (BME).....	C-4
C.3—Obsolete Elements from CoRe Guide.....	C-5
Appendix D—Migration from CoRe Elements.....	D-1
D.1—Deck Elements	D-1
D.1.1—Concrete.....	D-1
D.1.2—Steel	D-4
D.1.3—Timber.....	D-6
D.2—Superstructure, Substructure, and Culvert (SSC) Elements	D-8
D.2.1—Steel	D-8
D.2.2—Concrete.....	D-13
D.2.3—Timber.....	D-15
D.3—Other Elements	D-15
D.3.1—Joints.....	D-15
D.3.2—Bearings	D-16
D.3.3—Traffic Rails	D-17
References.....	R-1

INTRODUCTION

The proper assessment of the condition of bridge elements is the cornerstone of sound bridge management. The introduction of element inspection condition methods in the early 1990s represented a significant advancement in the bridge inspection practice and has been adopted by the vast majority of all State Transportation Departments in the United States. Bridge owners nationwide have recognized the benefits of detailed condition assessments through the use of the raw inspection information, expanded performance measures, and bridge management system deterioration forecasting and evaluation. As the use of element level inspection techniques has proliferated, the need for improvements has been identified. This manual incorporates improvements through changes in the measurement units of decks and slabs, the development of a wearing surface element, the standardization of the number of element states, the development of a protective coating element, and the incorporation of expanded element Smart Flags. The goal of this manual is to completely capture the condition of bridges in a simple way that can be standardized across the nation while providing the flexibility to be adapted to both large and small agency settings. This manual is not intended to supplant proper training or the exercise of engineering judgment by the inspector or professional engineer.

Section 1—Background

1.1—Condition Assessment Philosophy: Multi-Path And Defect Concepts

The Bridge Element Inspection Manual builds on the element level condition assessment methods developed in the AASHTO Guide for Commonly Recognized Structural Elements. Improvements have been made to fully capture the condition of the elements by reconfiguring the element language to utilize multiple distress paths within the defined condition states. The multi-path distress language provides the means to fully incorporate all possible defects within the overall condition assessment of the element. The overall condition of an element can be utilized in this aggregate form, or broken down into specific defects present as desired by the agency for Bridge Management System (BMS) use.

The Bridge Element Inspection Manual provides a comprehensive set of bridge elements that is designed to be flexible in nature to satisfy the needs of all agencies. The complete set of elements capture the components necessary for an agency to manage all aspects of the bridge inventory utilizing the full capability of a BMS.

The element set presented within includes two element types identified as National Bridge Elements (NBE) or Bridge Management Elements (BME). The combination of these two element types comprise the full AASHTO element set. All of the elements, whether they are NBE or BME, have the same general requirements:

1. Standard number of condition states
2. The standard number of condition states are comprised of good, fair, poor, and severe general descriptions

1.2—National Bridge Elements (NBEs)

The National Bridge Elements represent the primary structural components of bridges necessary to determine the overall condition and safety of the primary load carrying members. The NBEs are a refinement of the deck, superstructure, substructures, and culvert condition ratings defined in the Federal Highway Administration's Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges. Additional elements included in this section are bridge rail and bearings. The NBEs are designed to remain consistent from agency to agency across the country in order to facilitate the capture of bridge element condition at the national level.

1.3—Bridge Management Elements (BMEs)

Bridge Management Elements include components of bridges such as joints, wearing surfaces, and protective coating systems that are typically managed by agencies utilizing Bridge Management Systems. The BMEs represent a recommended set of condition assessment language that can be modified to suit the agencies needs as these elements are not intended to be utilized for the purposes of national policy making. The BMEs defined within this manual were purposefully left fairly general in nature to provide the flexibility to develop agency specific elements that best suit the local bridge preservation practices.

1.4—Agency Developed Elements

The elements presented within provide the flexibility for an agency to define custom elements in accordance with the defined element framework that can be subelements of NBEs, BMEs, or state defined elements without ties to the elements contained in this manual.

By defining a comprehensive set of bridge elements necessary for robust bridge management and the minimum set of elements necessary to assess the condition of primary components of bridges, the Bridge Element Inspection Manual provides a flexible element set that can be tailored to the needs of all agencies.

1.5—How to Use This Manual

Bridge inspection based on this manual consists of defining the elements (pieces of the bridge) and total quantities that exist at each bridge. The condition of each element is determined by performing a field inspection and recording quantities of the element that have identified defects that correlate to the severity of the defects defined in the particular condition state definition of this Manual. The condition assessment is complete when the appropriate portion of the total quantity is stratified over the defined condition states. For agencies utilizing bridge management systems, the appropriate element Smart Flags and environment shall be recorded for use in deterioration modeling.

This manual attempts to cover the vast majority of all bridge elements found on highway bridges in the United States. An inspector may find materials or elements that are not defined during the course of their inspection. In these cases, the inspector should use judgment to select the closest element match. In a similar vein, there may be cases when the specific condition observed in the field is not defined in this manual. In these cases, the inspector should use the general description of the condition states to determine the appropriate condition.

The granularity of the defect details is typically eliminated for condition state 4 as this state is reserved for severe conditions that are beyond those specific defects defined in states 1 through 3 and may often have load capacity implications.

The appendix section will provide guidance on the use of this manual. There are four appendices to aid an agency in the development of their data collection process. These appendices are:

- A—Agency Developed Elements
- B—Inspection Examples
- C—Element Grouping
- D—Element Migration Process

Section 2—Element Location Matrix

This section is designed to give inspectors a quick reference guide to the defined elements. The matrix organizes the elements by general element type, material, and in accordance to their physical location on the bridge to facilitate ease of use by bridge inspectors in the field. Appendix C contains a flowchart of element changes from the AASHTO commonly recognized element set.

2.1—National Bridge Elements

2.1.1—Decks/Slabs

Element	Units	Element Number (Decks)	Element Number (Slab)	Other
Reinforced Concrete Deck/Slab	AREA	12	38	
Prestressed/Reinforced Concrete Top Flange	AREA	15		
Steel Deck—Open Grid	AREA	28		
Steel Deck—Concrete Filled Grid	AREA	29		
Steel Deck—Corrugated/Orthotropic/Etc.	AREA	30		
Timber Deck/Slab	AREA	31	54	
Bridge Rail		Other		
Metal Bridge Railing	LENGTH			330
Reinforced Concrete Bridge Railing	LENGTH			331
Timber Bridge Railing	LENGTH			332
Other Bridge Railing	LENGTH			333
Masonry Bridge Railing	LENGTH			334

AREA = ft² (m²)

LENGTH= ft (m)

2.1.2—Superstructure

Element	Units	Steel	Prestressed Concrete	Reinforced Concrete	Timber	Masonry	Other
Girder/Beam	LENGTH	107	109	110	111		
Closed Web/Box Girder	LENGTH	102	104	105			
Stringer	LENGTH	113	115	116	117		
Truss	LENGTH	120			135		
Arch	LENGTH	141	143	144	146	145	
Floor Beam	LENGTH	152	154	155	156		
Cable	EA	147, 148					
Gusset Plate	EA	162					
Pin, Pin and Hanger Assembly, or both	EA	161					

LENGTH= ft (m)

EA = each

2.1.3—Substructure

Element	Units	Steel	Prestressed Concrete	Reinforced Concrete	Timber	Masonry	Other
Column/Pile Extension	EA	202	204	205	206		
Column Tower (Trestle)	EA	207			208		
Submerged Pile	EA	225	226	227	228		
Pier Wall	LENGTH			210	212	213	211
Abutment	LENGTH	219		215	216	217	218
Pier Cap	LENGTH	231	233	234	235		
Pile Cap/Footing	EA			220			
Culvert	LENGTH	240		241	242	244	243
Bearings							
Elastomeric Bearing	EA						310
Moveable Bearing (roller, sliding, etc.)	EA						311
Enclosed/Concealed Bearing	EA						312
Fixed Bearing	EA						313
Pot Bearing	EA						314
Disk Bearing	EA						315

LENGTH= ft (m)

EA = each

2.2—Bridge Management Elements

2.2.1—Decks/Slabs

Element	Units	Element Number
Joints		
Strip Seal Expansion Joint	LENGTH	300
Pourable Joint Seal	LENGTH	301
Compression Joint Seal	LENGTH	302
Assembly Joint/Seal (Modular)	LENGTH	303
Open Expansion Joint	LENGTH	304
Assembly Joint without Seal	LENGTH	305
Approach Slabs		
P/S Concrete Approach Slab	AREA	320
Reinforced Concrete Approach Slab	AREA	321

AREA = ft² (m²)

LENGTH= ft (m)

EA = Each

2.2.2—Wearing Surfaces and Protection Systems

Element	Units	Element Number
Protective Systems		
Wearing Surfaces	AREA	510
Steel Protective Coating	AREA	515
Deck/Slab Protection Systems	AREA	520
Concrete Protective Coating	AREA	521

AREA = ft² (m²)

2.2.3—Smart Flags (Defect Flags)

Smart Flags	Element Number
Steel Cracking/Fatigue	356
Pack Rust	357
Concrete Cracking	358
Concrete Efflorescence	359
Settlement	360
Scour	361
Superstructure Traffic Impact (load capacity)	362
Steel Section Loss	363
Steel Out-of-Plane (Compression Members)	364
Deck Traffic Impact (load capacity)	366
Substructure Traffic Impact (load capacity)	367
Culvert Barrel Distortion	368

Section 3—Detailed Element Descriptions

This section describes the elements detailed use in inspection and bridge management. The detailed description is broken down into six sections:

1. Description—Detailed identification of the element
2. Quantity Calculation—General guideline on how to collect the quantity of the element
3. Condition State Definitions—Defect description and severity
4. Feasible Actions—The actions an agency can take to remove the defect (these are needed for Bridge Management Systems)
5. Element Commentary—additional considerations for the inspector during data collection
6. Element Definitions—Guidelines to the inspector for defect severity categorization

The elements listed in this section will be divided into NBE and BME.

3.1—National Bridge Elements

This section describes in detail those elements that are primary structure elements.

3.1.1—Decks/Slabs

These elements describe the component that is transferring load from the vehicle to the bridge. This section does not include secondary deck elements such as joints, deck/slab protection systems, or wearing surfaces.

Deck structures transmit the loads into superstructure systems. Slab elements transmit the load into the substructure. Structures that include slab elements typically do not have superstructure elements. These elements transmit traffic loads directly into the substructure. All deck or slab elements can be supplemented with one or more associated protection system or wearing surface elements.

Description This element defines all reinforced concrete bridge deck/slab regardless of the wearing surface or protection systems used.	Element #12/38 Reinforced Concrete Deck/Slab ft ² (m ²) National Bridge Elements
---	--

Quantity Calculation

The quantity for this element should include the area of the deck/slab from edge to edge including any median areas and accounting for any flares or ramps present.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Cracking	None to hairline	Narrow size or density, or both	Medium size or density, or both	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Spalls/Delaminations/Patched Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress	
Efflorescence	None	Moderate without rust	Severe with rust staining	
Load Capacity	No reduction	No reduction	No reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect Repair	Do Nothing Protect Repair Rehab	Do Nothing Protect Replace

Element Commentary

The deck/slab evaluation is three dimensional in nature with the defects observed on the top surface, bottom surface, or both, and being captured using the defined condition states. Deck/Slab top or bottom surfaces that are not visible for inspection shall be assessed based on the available visible surface. If both top and bottom surfaces are not visible, the condition shall be assessed based on destructive and nondestructive testing or indicators in the materials covering the surfaces.

Element Definitions

Defect	Hairline–Minor	Narrow–Moderate	Medium–Severe
Cracking	< 0.0625 in. (1.6 mm)	0.0625–0.125 in. (1.6–3.2 mm)	>0.125 in. (3.2 mm)
Spalls/Delaminations	NA	Spall less than 1 in. (25 mm) deep or less than 6 in. in diameter and no exposed rebar	Spall greater than 1 in. (25 mm) deep or greater than 6 in. in diameter or exposed rebar
Cracking Density	Spacing greater than 3.0 ft (0.33 m)	Spacing of 1.0–3.0 ft (0.33–1.0 m)	Spacing of less than 1 ft (0.33 m)
Efflorescence	NA	Surface white without build-up or leaching	Heavy build-up with rust staining

Element #15 Prestressed/Reinforced Concrete Top Flange ft ² (m ²) National Bridge Elements	Description This element defines those bridge girder top flanges that are exposed to traffic. This element defines all prestressed and reinforced concrete bridge girder top flanges regardless of the wearing surface or protection systems used. These bridge types include tee-beams, bulb-tees, and girders that require traffic to ride on the top flange.
--	---

Quantity Calculation

The quantity for this element should include the area of the deck/slab from edge to edge including any median areas and accounting for any flares or ramps present. This quantity is for the top flange riding surface only. Girder web and bottom flange to be evaluated by the appropriate girder element.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Cracking	None to hairline	Narrow size or density, or both	Medium size or density, or both	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Spalls/Delaminations/Patched Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress	
Efflorescence	None	Moderate without rust	Severe with rust staining	
Load Capacity	No reduction	No reduction	No reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect Repair	Do Nothing Protect Repair Rehab	Do Nothing Repair Rehab Replace

Element Commentary

The flange evaluation is three dimensional in nature with the defects observed on the top surface, bottom surface, or both, and being captured using the defined condition states. Flange top or bottom surfaces that are not visible for inspection shall be assessed based on the available visible surface. If both top and bottom surfaces are not visible, the condition shall be assessed based on destructive and nondestructive testing, or indicators in the materials covering the surfaces.

Element Definitions

Defect	Hairline–Minor	Narrow–Moderate	Medium–Severe
Cracking	< 0.0625 in. (1.6 mm)	0.0625–0.125 in. (1.6–3.2 mm)	>0.125 in. (3.2 mm)
Spalls/Delaminations	NA	Spall less than 1 in. (25 mm) deep or less than 6 in. in diameter, and no exposed rebar	Spall greater than 1 in. (25 mm) deep or greater than 6 in. in diameter or exposed rebar
Cracking Density	Spacing greater than 3.0 ft (0.33 m)	Spacing of 1.0–3.0 ft (0.33–1.0 m)	Spacing of less than 1 ft (0.33 m)
Efflorescence	NA	Surface white without build-up or leaching	Heavy build-up with rust staining

Description This element defines all open grid steel bridge decks with no fill.	Element #28 Steel Deck with Open Grid ft ² (m ²) National Bridge Element
---	--

Quantity Calculation

The quantity for this element should include the area of the deck/slab from edge to edge including any median areas and accounting for any flares or ramps present.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Corrosion	None	Freckled Rust	Section Loss	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Connections	Sound	Sound	Isolated Failures	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

The deck evaluation is three dimensional in nature with the defects observed on the top surface, bottom surface, or both, and being captured using the defined condition states.

Element Definitions

	Sound	Isolated Failure
Connections	Connectors are in place and functioning	Connectors are loose, missing, or broken

	Freckled Rust	Section Loss
Corrosion	Corrosion of the steel has initiated	Steel section loss is evident without impact on load capacity

Element #29 Steel Deck with Concrete Filled Grid ft ² (m ²) National Bridge Element	Description This element defines steel bridge decks with concrete fill either in all of the openings or within the wheel tracks.
---	--

Quantity Calculation

The quantity for this element should include the area of the deck from edge to edge including any median areas and accounting for any flares or ramps present.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Corrosion	None	Freckled Rust	Section Loss	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Concrete	Sound	Sound	Isolated Failures	
Connections	Sound	Sound	Isolated Failures	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

The deck evaluation is three dimensional in nature with the defects observed on the top surface, bottom surface, or both, and being captured using the defined condition states.

Element Definitions

	Sound	Isolated Failure
Concrete	Tightly adhered to the grid and in good condition	Missing, deteriorated, or loose concrete
Connections	Connectors are in place and functioning	Connectors are loose, missing, or broken

	Freckled Rust	Section Loss
Corrosion	Corrosion of the steel has initiated	Steel pitting is evident without impact on load capacity

Description This element defines those bridge decks constructed of corrugated metal filled with portland cement, asphaltic concrete, or other riding surfaces. Orthotropic steel decks are also included.	Element #30 Steel Deck Corrugated/Orthotropic/Etc. ft ² (m ²) National Bridge Elements
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Quantity Calculation

The quantity for this element should include the area of the deck from edge to edge including any median areas and accounting for any flares or ramps present.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Corrosion	None	Freckled Rust	Section Loss	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

The deck evaluation is three dimensional in nature with the defects observed on the top surface, bottom surface, or both, and being captured using the defined condition states. Materials added for riding surface is not part of the element condition.

Element Definitions

	Freckled Rust	Section Loss
Corrosion	Corrosion of the steel has initiated	Steel section loss is evident without impact on load capacity

Element #31/54 Timber Deck/Slab ft ² (m ²) National Bridge Elements	Description This element defines all timber bridge deck/slab regardless of the wearing surface or protection systems used.
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Quantity Calculation

The quantity for this element should include the area of the deck/slab from edge to edge including any median areas and accounting for any flares or ramps present.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Decay	None	None	Moderate	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Checks/Shingles	Minor	Moderate	Severe	
Cracks	None	None	Minor	
Splits	Minor	Minor to Moderate	Minor to Moderate	
Abrasion	Minor	Minor	Moderate	
Load Capacity	No reduction	No reduction	No reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect Repair	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

The deck/slab evaluation is three dimensional in nature with the defects observed on the top and bottom surface, or both, and being captured using the defined condition states.

Element Definitions

Defect	Minor	Moderate	Severe
Decay	Surface penetration only	Less than 10% of the thickness of the member	Decay greater than 10% of the thickness of the member, in tension zones, or both
Checks/Shingles	Surface level and does not penetrate more than 5% of the member thickness	Defect does not penetrate more than 50% of the thickness of the member, in the areas of neutral axis, or both	Defect penetrating more than 50% of the thickness of the member, in areas of the tension zone, or both.
Splits	Lengthwise separation of wood from one surface through to the opposite or adjacent surface. Length does not exceed the depth of the member.	Length of the split is less than 25% of the member length.	Length of the split is greater than 25% of the member length.
Abrasion	Surface level and no section loss	Section loss less than 10% of the thickness of the member	Section loss more than 10% of the thickness of the member
Cracks	Propagates from a compression zone surface or propagates from a tension surface but penetrates less than 10% of the depth of the member	Propagates from a tension zone surface to a depth not greater than 50% of the member depth	Propagates from a tension zone to a depth greater than 50% of the member depth

3.1.2—Superstructure

Superstructure elements described in this section are to transmit load from decks into the substructure. These elements include girders, trusses, arches, and floor systems. The floor systems include floor beams and stringers. Additional elements in this group include cables, gusset plates, and pin and hanger assemblies. These elements do not include bracing components such as diaphragms, cross bracing, or portal sway bracing.

3.1.2.1—Girders

These elements transmit the loads from the deck into the substructure. Elements listed include closed web (boxes) and open girders (I sections). The materials include steel, concrete, and timber.

Description This element defines all steel box girders or closed web girders, and is for all box girders regardless of protective system.	Element #102 Steel Closed Web/Box Girder ft (m) National Bridge Element
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Quantity Calculation

The quantity for this element is the sum of all the lengths of each box girder section. The quantity can be determined by counting the visible web faces, dividing by two, and then multiply by the appropriate length.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Corrosion	None	Freckled Rust	Section Loss	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Cracking/Fatigue	None	Arrested Cracks Exist	Moderate Cracks Exist	
Connections	Sound	Sound	Isolated Failures	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

The box girder evaluation is three dimensional in nature with the defects observed on exterior and interior surfaces being used to capture the condition states.

Element Definitions

	Freckled Rust	Section Loss
Corrosion	Corrosion of the steel has initiated	Steel pitting is evident without impact on load capacity

	Sound	Isolated Failure
Connections	Connections are in place and functioning as intended	Missing bolts/rivets, broken welds, or a severed connection

	Arrested	Moderate
Cracking/Fatigue	Cracks with arrest holes, doubling plates, or similar in place	Identified cracks that are not arrested or otherwise addressed

Element #104 Prestressed Concrete Closed Web/Box Girder ft (m) National Bridge Elements	Description This element defines pretensioned or post-tensioned concrete closed web girder or box girder, and is for all box girders regardless of protective system.
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each girder. The quantity can be determined by counting the visible web faces, dividing by two, and then multiply by the appropriate length.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Spalls/Delaminations/Patch Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Exposed Rebar	None	None	Corrosion without section loss	
Exposed Prestressing	None	None	Present with no section loss	
Cracks	Hairline cracks only	Narrow size or density	Medium size or density	
Efflorescence	None	Moderate but without rust	Severe with rust staining	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

The box girder evaluation is three dimensional in nature which includes defect observed on exterior and interior surfaces. If the riding surface is the exposed top surface, evaluation of the riding surface above the fillet should be considered with element 15.

Element Definitions

Defect	Hairline–Minor	Narrow–Moderate	Medium–Severe
Cracking	< 0.004 in. (0.1 mm)	0.004–0.009 in. (0.1–0.23 mm)	>0.009 in. (0.23 mm)
Cracking Density	NA	1.0–3.0 ft apart (0.33–1.0 m)	< 1 ft (0.33 m)
Efflorescence	NA	Surface white without build-up or leaching	Heavy build-up with rust staining
Spalls/Delaminations	NA	Spall less than 1 in. (25 mm) deep or less than 6 in. in diameter	Spall greater than 1 in. (25 mm) deep or greater than 6 in. in diameter or exposed rebar

Description This element defines a reinforced concrete box girder or closed web girder, and is for all box girders regardless of the protective system	Element #105 Reinforced Concrete Closed Web/Box Girder ft (m) National Bridge Element
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Quantity Calculation

The quantity for this element is the sum of all the lengths of each girder. The quantity can be determined by counting the visible web faces, dividing by two, and then multiply by the appropriate length.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Cracking	None to hairline	Narrow size or density, or both	Medium size or density, or both	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Spalls/Delaminations/Patched Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress	
Efflorescence	None	Moderate without rust	Severe with rust staining	
Load Capacity	No reduction	No reduction	No reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

The box girder evaluation is three dimensional in nature with the defects observed including exterior and interior surfaces being used to capture the condition states. If the riding surface is the exposed top surface, evaluation of the riding surface above the fillet should be considered with element 15.

Element Definitions

Defect	Hairline—Minor	Narrow—Moderate	Medium—Severe
Cracking	< 0.0625 in. (1.6 mm)	0.0625–0.125 in. (1.6–3.2 mm)	>0.125 in. (3.2 mm)
Spalls/Delaminations	NA	Spall less than 1 in. (25 mm) deep or less than 6 in. in diameter	Spall greater than 1 in. (25 mm) deep or greater than 6 in. in diameter or exposed rebar
Cracking Density	Spacing greater than 3.0 ft (0.33 m)	Spacing of 1.0–3.0 ft (0.33–1.0 m)	Spacing of less than 1 ft (0.33 m)
Efflorescence	NA	Surface white without build-up or leaching	Heavy build-up with rust staining

Element #107 Steel Open Girder/Beam ft (m) National Bridge Elements	Description This element defines all steel open girders, and is for all girders regardless of protective system.
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Quantity Calculation

The quantity for this element is the sum of all the lengths of each girder.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Corrosion	None	Freckled Rust	Section Loss	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Cracking/Fatigue	None	Arrested Cracks Exist	Moderate Exists	
Connections	Sound	Sound	Isolated Failures	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

Condition evaluation for this element includes the web face and the top and bottom faces of the flange.

Element Definitions

	Freckled Rust	Section Loss
Corrosion	Corrosion of the steel has initiated	Steel pitting is evident without impact on load capacity
	Sound	Isolated Failure
Connections	Connections are in place and functioning as intended	Missing bolts/rivets, broken welds, or a severed connection
	Arrested	Moderate
Cracking/Fatigue	Cracks with arrest holes, doubling plates, or similar in place	Identified cracks that are not arrested or otherwise addressed

Description This element defines pretensioned or post-tensioned concrete open web girders, and is for all girders regardless of protective system.	Element #109 Prestressed Concrete Girder/Beam ft (m) National Bridge Element
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Quantity Calculation

The quantity for this element is the sum of all the lengths of each girder.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Spalls/Delaminations/Patch Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Exposed Rebar	None	None	Corrosion without section loss	
Exposed Prestressing	None	None	Present with no section loss	
Cracks	Hairline cracks only	Narrow size or density	Medium size or density	
Efflorescence	None	Moderate but without rust	Severe with rust staining	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

Condition evaluation included the web faces and the top and bottom flange surfaces. If the riding surface is the exposed top surface, evaluation of the riding surface above the fillet should be considered with element 15.

Element Definitions

Defect	Hairline–Minor	Narrow–Moderate	Medium–Severe
Cracking	< 0.004 in. (0.1 mm)	0.004–0.009 in. (0.1–0.23 mm)	>0.009 in. (0.23 mm)
Cracking Density	NA	1.0–3.0 ft apart (0.33–1.0 m)	< 1 ft (0.33 m)
Efflorescence	NA	Surface white without build-up or leaching	Heavy build-up with rust staining
Spalls/Delaminations/Patched Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress

Element #110 Reinforced Concrete Girder/Beam ft (m) National Bridge Element	Description This element defines mild steel reinforced concrete open web girders, and is for all girders regardless of protective system.
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each girder.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Cracking	None to hairline	Narrow size or density, or both	Medium size or density, or both	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Spalls/Delaminations/Patched Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress	
Efflorescence	None	Moderate without rust	Severe with rust staining	
Load Capacity	No reduction	No reduction	No reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

If the riding surface is the exposed top surface, evaluation of the riding surface above the fillet should be considered with element 15.

Element Definitions

Defect	Hairline–Minor	Narrow–Moderate	Medium–Severe
Cracking	< 0.0625 in. (1.6 mm)	0.0625–0.125 in. (1.6–3.2 mm)	>0.125 in. (3.2 mm)
Spalls/Delaminations	NA	Spall less than 1 in. (25 mm) deep or less than 6 in. in diameter	Spall greater than 1 in. (25 mm) deep or greater than 6 in. in diameter or exposed rebar
Cracking Density	Spacing greater than 3.0 ft (0.33 m)	Spacing of 1.0–3.0 ft (0.33–1.0 m)	Spacing of less than 1 ft (0.33 m)
Efflorescence	NA	Surface white without build-up or leaching	Heavy build-up with rust staining

Description This element defines all timber girders, and is for all girders regardless of protection system.	Element #111 Timber Open Girder ft (m) National Bridge Element
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Quantity Calculation

The quantity for this element is the sum of all the lengths of each girder.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Decay	None	None	Moderate	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Checks/Shingles	Minor	Moderate	Severe	
Cracks	None	None	Minor	
Splits	Minor	Minor to Moderate	Minor to Moderate	
Abrasion	Minor	Minor	Moderate	
Load Capacity	No reduction	No reduction	No reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect Repair	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

None

Element Definitions

Defect	Minor	Moderate	Severe
Decay	Surface penetration only	Less than 10% of the thickness of the member	Decay greater than 10% of the thickness of the member or in tension zones, or both
Checks/Shingles	Surface level and does not penetrate more than 5% of the member thickness	Defect does not penetrate more than 50% of the thickness of the member and in the areas of neutral axis, or both	Defect penetrating more than 50% of the thickness of the member and in areas of the tension zone, or both
Splits	Lengthwise separation of wood from one surface through to the opposite or adjacent surface. Length does not exceed the depth of the member.	Length of the split is less than 25% of the member length	Length of the split is greater than 25% of the member length
Abrasion	Surface level, no section loss	Section loss no less than 10% of the thickness of the member	Section loss more than 10% of the thickness of the member
Cracks	Propagates from a compression zone surface or propagates from a tension surface but penetrates less than 10% of the depth of the member	Propagates from a tension zone surface to a depth not greater than 50% of the member depth	Propagates from a tension zone to a depth greater than 50% of the member depth

3.1.2.2—Stringers

These superstructure elements are part of a floor system, and transmit load from the deck into the floor system, such as floor beams.

Description This element defines steel members that support the deck in a stringer floor beam system, and is for all stringers regardless of protective system.	Element #113 Steel Stringer ft (m) National Bridge Element
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each stringer.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Corrosion	None	Freckled Rust	Section Loss	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Cracking/Fatigue	None	Arrested Cracks Exist	Cracks Exist	
Connections	Sound	Sound	Isolated Failures	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

Condition evaluation for this element includes the web face and the top and bottom faces of the flange.

Element Definitions

	Freckled Rust	Section Loss
Corrosion	Corrosion of the steel has initiated	Steel pitting is evident without impact on load capacity

	Sound	Isolated Failure
Connections	Connections are in place and functioning as intended	Missing bolts/rivets, broken welds or a severed connection

	Arrested	Moderate
Cracking/Fatigue	Cracks with arrest holes, doubling plates, or similar in place	Identified cracks that are not arrested or otherwise addressed

Element #115 Prestressed Concrete Stringer ft (m) National Bridge Element	Description This element defines pretensioned or post-tensioned concrete members that support the deck in a stringer floor beam system, and is for all stringers regardless of protective system.
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each stringer.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Spalls/Delaminations/Patch Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Exposed Rebar	None	None	Corrosion without section loss	
Exposed Prestressing	None	None	Present without Section Loss	
Cracks	Hairline cracks only	Narrow size or density	Moderate size and density	
Efflorescence	None	Moderate but without rust	Severe with rust staining	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

Condition evaluation included the web faces and the top and bottom flange surfaces.

Element Definitions

Defect	Hairline–Minor	Narrow–Moderate	Medium–Severe
Cracking	< 0.004 in. (0.1 mm)	0.004–0.009 in. (0.1–0.23 mm)	>0.009 in. (0.23 mm)
Cracking Density	NA	1.0–3.0 ft apart (0.33–1.0 m)	< 1 ft (0.33 m)
Efflorescence	NA	Surface white without build-up or leaching	Heavy build-up with rust staining
Spalls/Delaminations/Patched Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress

Description This element defines mild steel reinforced concrete members that support the deck in a stringer floor beam system, and is for all stringers regardless of protective system.	Element #116 Reinforced Concrete Stringer ft (m) National Bridge Element
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each stringer.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Cracking	None to hairline	Narrow size or density, or both	Medium size or density, or both	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Spalls/Delaminations/Patched Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress	
Efflorescence	None	Moderate without rust	Severe with rust staining	
Load Capacity	No reduction	No reduction	No reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

None

Element Definitions

Defect	Hairline–Minor	Narrow–Moderate	Medium–Severe
Cracking	< 0.0625 in. (1.6 mm)	0.0625–0.125 in. (1.6–3.2 mm)	>0.125 in. (3.2 mm)
Spalls/Delaminations	NA	Spall less than 1 in. (25 mm) deep or less than 6 in. in diameter	Spall greater than 1 in. (25 mm) deep or greater than 6 in. in diameter or exposed rebar
Cracking Density	Spacing greater than 3.0 ft (0.33 m)	Spacing of 1.0–3.0 ft (0.33–1.0 m)	Spacing of less than 1 ft (0.33 m)
Efflorescence	NA	Surface white without build-up or leaching	Heavy build-up with rust staining

Element #117 Timber Stringer ft (m) National Bridge Element	Description This element defines timber members that support the deck in a stringer floor beam system, and is for all stringers regardless of protective system.
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each stringer.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Decay	None	None	Moderate	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Checks/Shingles	Minor	Moderate	Severe	
Cracks	None	None	Minor	
Splits	Minor	Minor to Moderate	Minor to Moderate	
Abrasion	Minor	Minor	Moderate	
Load Capacity	No reduction	No reduction	No reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect Repair	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

None

Element Definitions

Defect	Minor	Moderate	Severe
Decay	Surface penetration only	Less than 10% of the thickness of the member	Decay greater than 10% of the thickness of the member, in tension zones, or both
Checks/Shingles	Surface level and does not penetrate more than 5% of the member thickness	Defect does not penetrate more than 50% of the thickness of the member, in the areas of neutral axis, or both	Defect penetrating more than 50% of the thickness of the member, in areas of the tension zone, or both
Splits	Lengthwise separation of wood from one surface through to the opposite or adjacent surface. Length does not exceed the depth of the member.	Length of the split is less than 25% of the member length	Length of the split is greater than 25% of the member length
Abrasion	Surface level, no section loss	Section loss no less than 10% of the thickness of the member	Section loss more than 10% of the thickness of the member
Cracks	Propagates from a compression zone surface or propagates from a tension surface but penetrates less than 10% of the depth of the member	Propagates from a tension zone surface to a depth not greater than 50% of the member depth	Propagates from a tension zone to a depth greater than 50% of the member depth

3.1.2.3—Trusses/Arches

These superstructure elements include materials of steel, concrete, timber, and masonry, and are the main load carrying member for the span.

Description This element defines all steel truss elements, including all tension and compression members, and through and deck trusses. It is for all trusses regardless of protective system.	Element #120 Steel Truss ft (m) National Bridge Elements
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each truss panel measured longitudinal to the travel way.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Corrosion	None	Freckled Rust	Section Loss	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Cracking/Fatigue	None	Arrested Cracks Exist	Moderate Cracks Exist	
Connections	Sound	Sound	Isolated Failures	
Compression Members	No Out-of-Plane Members	Arrested Out-of-Plane Bending Exists	Out-of-Plane Members Exist	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

Distress observed on truss diagonals shall be reported as the length projected along the truss length.

Element Definitions

	Freckled Rust	Section Loss
Corrosion	Corrosion of the steel has initiated	Steel pitting is evident without impact on load capacity

	Sound	Isolated Failure
Connections	Connections are in place and functioning as intended	Missing bolts/rivets, broken welds, or a severed connection

	Arrested	Moderate
Cracking/Fatigue	Cracks with arrest holes, doubling plates, or similar in place.	Identified cracks that are not arrested or otherwise addressed

Element #135 Timber Truss ft (m) National Bridge Element	Description This element defines all timber truss elements, including all tension and compression members, and through and deck trusses. It is for all trusses regardless of protective system.
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each truss panel measured longitudinal to the travel way.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Decay	None	None	Moderate	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Checks/Shingles	Minor	Moderate	Severe	
Cracks	None	None	Minor	
Splits	Minor	Minor to Moderate	Minor to Moderate	
Abrasion	Minor	Minor	Moderate	
Load Capacity	No reduction	No reduction	No reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect Repair	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

Observed distress in truss diagonal members shall be reported as the projected length along the length of the truss.

Element Definitions

Defect	Minor	Moderate	Severe
Decay	Surface penetration only	Less than 10% of the thickness of the member	Decay greater than 10% of the thickness of the member, is in tension zones, or both
Checks/Shingles	Surface level and does not penetrate more than 5% of the member thickness	Defect does not penetrate more than 50% of the thickness of the member, is in the areas of neutral axis, or both	Defect penetrating more than 50% of the thickness of the member, is in areas of the tension zone, both
Splits	Lengthwise separation of wood from one surface through to the opposite or adjacent surface. Length does not exceed the depth of the member.	Length of the split is less than 25% of the member length	Length of the split is greater than 25% of the member length
Abrasion	Surface level, no section loss	Section loss no less than 10% of the thickness of the member	Section loss more than 10% of the thickness of the member
Cracks	Propagates from a compression zone surface or propagates from a tension surface but penetrates less than 10% of the depth of the member	Propagates from a tension zone surface to a depth not greater than 50% of the member depth	Propagates from a tension zone to a depth greater than 50% of the member depth

Description This element defines steel arches regardless of type, and is for all arches regardless of protective system.	Element #141 Steel Arch ft (m) National Bridge Element
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each arch panel measured longitudinal to the travel way.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Corrosion	None	Freckled Rust	Section Loss	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Cracking/Fatigue	None	Arrested Cracks Exist	Moderate Cracks Exist	
Connections	Sound	Sound	Isolated Failures	
Compression Members	No Out-of-Plane Members	Arrested Out-of-Plane Bending Exists	Out-of-Plane Members Exist	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

Observed distress in arch diagonals shall be reported as the projected length along the arch length.

Element Definitions

	Freckled Rust	Section Loss
Corrosion	Corrosion of the steel has initiated	Steel pitting is evident without impact on load capacity
	Sound	Isolated Failure
Connections	Connections are in place and functioning as intended	Missing bolts/rivets, broken welds, or a severed connection
	Arrested	Moderate
Cracking/Fatigue	Cracks with arrest holes, doubling plates, or similar in place	Identified cracks that are not arrested or otherwise addressed

Element #143 Prestressed Concrete Arch ft (m) National Bridge Element	Description This element defines only pretensioned or post-tensioned concrete arches, and is for all arches regardless of protective system.
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Quantity Calculation

The quantity for this element is the sum of the length of each arch panel measured longitudinal to the travel way.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Spalls/Delaminations/Patch Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Exposed Rebar	None	None	Corrosion without section loss	
Exposed Prestressing	None	None	Present with no section loss	
Cracks	Hairline cracks only	Narrow size or density	Medium size or density	
Efflorescence	None	Moderate but without rust	Severe with rust staining	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

None

Element Definitions

Defect	Hairline–Minor	Narrow–Moderate	Medium–Severe
Cracking	< 0.004 in. (0.1 mm)	0.004–0.009 in. (0.1–0.23 mm)	>0.009 in. (0.23 mm)
Cracking Density	NA	1.0–3.0 ft apart (0.33–1.0 m)	< 1 ft (0.33 m)
Efflorescence	NA	Surface white without build-up or leaching	Heavy build-up with rust staining
Spalls/Delaminations	NA	Spall less than 1 in. (25 mm) deep or less than 6 in. in diameter	Spall greater than 1 in. (25 mm) deep or greater than 6 in. in diameter or exposed rebar

Description This element defines only mild steel reinforced concrete arches, and is for all arches regardless of protective system.	Element #144 Reinforced Concrete Arch ft (m) National Bridge Element
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each arch panel measured longitudinal to the travel way.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Cracking	None to hairline	Narrow size or density, or both	Medium size or density, or both	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Spalls/Delaminations/Patched Areas	None	Moderate spall or patch areas that are sound	Severe spall or patched area showing distress	
Efflorescence	None	Moderate without rust	Severe with rust staining	
Load Capacity	No reduction	No reduction	No reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

None

Element Definitions

Defect	Hairline–Minor	Narrow–Moderate	Medium–Severe
Cracking	< 0.0625 in. (1.6 mm)	0.0625–0.125 in. (1.6–3.2 mm)	>0.125 in. (3.2 mm)
Spalls/Delaminations	NA	Spall less than 1 in. (25 mm) deep or less than 6 in. in diameter	Spall greater than 1 in. (25 mm) deep or greater than 6 in. in diameter or exposed rebar
Cracking Density	Spacing greater than 3.0 ft (0.33 m)	Spacing of 1.0 –3.0 ft (0.33–1.0 m)	Spacing of less than 1 ft (0.33 m)
Efflorescence	NA	Surface white without build-up or leaching	Heavy build-up with rust staining

Element #145 Masonry Arch ft (m) National Bridge Element	Description This element defines masonry or stacked stone arches, and is for all arches regardless of protective system.
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each arch section measured longitudinal to the travel way.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Mortar Breakdown	None	Cracking, moderate voids, or both	Severe cracking or voids	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Block or Stone	Cracks are present but have not allowed the block or stone to shift	Cracks are present and block or stone has minor shifting	Block or stone is cracked with masonry face deformation. Block or stone are missing	
Efflorescence	None	Moderate but without rust	Severe with rust staining	
Patched Areas	None	Present	Present	
Load Capacity	No Reduction	No Reduction	No Reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

None

Element Definitions

Defect	Moderate	Severe
Cracking	0.02–0.08 in. (0.5–2.0 mm)	>0.08 in. (2.0 mm)
Cracking Density	1.0–3.0 ft apart (0.33–1.0 m)	< 1 ft (0.33 m)
Mortar Breakdown	Cracking or voids in less than 10% of joints	Cracking or voids in more than 10% of joints
Efflorescence	Surface white without build-up or leaching	Heavy build-up with rust staining

Description This element defines only timber arches, and is for all arches regardless of protective system.	Element #146 Timber Arch ft (m) National Bridge Element
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Quantity Calculation

The quantity for this element is the sum of all of the lengths of each arch panel measured longitudinal to the travel way.

Condition State Definitions

Defect	Condition State 1	Condition State 2	Condition State 3	Condition State 4
Decay	None	None	Moderate	The condition is beyond the limits established in condition state three (3), warrants a structural review to determine the strength or serviceability of the element or bridge, or both.
Checks/Shingles	Minor	Moderate	Severe	
Cracks	None	None	Minor	
Splits	Minor	Minor to Moderate	Minor to Moderate	
Abrasion	Minor	Minor	Moderate	
Load Capacity	No reduction	No reduction	No reduction	

Feasible Actions

Condition State 1	Condition State 2	Condition State 3	Condition State 4
Do Nothing Protect	Do Nothing Protect Repair	Do Nothing Protect Repair Rehab	Do Nothing Rehab Replace

Element Commentary

Observed distress in arch diagonal members shall be reported as the projected length along the arch.

Element Definitions

Defect	Minor	Moderate	Severe
Decay	Surface penetration only	Less than 10% of the thickness of the member	Decay greater than 10% of the thickness of the member, is in tension zones, or both
Checks/Shingles	Surface level and does not penetrate more than 5% of the member thickness	Defect does not penetrate more than 50% of the thickness of the member, is in the areas of neutral axis, or both	Defect penetrating more than 50% of the thickness of the member, is in areas of the tension zone, or both
Splits	Lengthwise separation of wood from one surface through to the opposite or adjacent surface. Length does not exceed the depth of the member.	Length of the split is less than 25% of the member length	Length of the split is greater than 25% of the member length
Abrasion	Surface level, no section loss	Section loss no less than 10% of the thickness of the member	Section loss more than 10% of the thickness of the member
Cracks	Propagates from a compression zone surface or propagates from a tension surface but penetrates less than 10% of the depth of the member.	Propagates from a tension zone surface to a depth not greater than 50% of the member depth	Propagates from a tension zone to a depth greater than 50% of the member depth

