# Readers Note and Acknowledgements

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 revisions as a reference for standardized element definitions, element quantity calculations, condition state definitions, element feasible actions and inspection conventions.

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# 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 1990's 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 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 Bridge Management System (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 requirement:

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 (NBE)

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 NBE's 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 National Bridge Elements 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 (BME)

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 Bridge Management Elements 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 BME's 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 sub-elements of NBE's, BME's 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 vain, 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.

## 1.6 REFERENCES

FHWA. 1995. Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges. Federal Highway Administration, U.S. Department of Transportation, Washington, DC.

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FHWA. 2006. Bridge Inspector's Reference Manual. Federal Highway Administration. U.S. Department of Transportation, Washington, DC.

NCHRP. 1999. "BRIDGIT" Bridge Management System Users Manual and Technical Manual, NCHRP Project 12-28 (A and B1), Transportation Research Board, National Research Council, Washington, DC.

NCHRP. 2007. Multi-Objective Optimization for Bridge Management, NCHRP Report 590, Transportation Research Board, National Research Council, Washington, DC.

# 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 = square feet (square meter)

LENGTH= feet (meters)

### 2.1.1 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 and/or Pin and Hanger Assembly | EA | 161 | | | | | |

LENGTH= feet (meters)

EA = Each

### 2.1.2 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= feet (meters)

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 w/o Seal | LENGTH | 305 |
| Approach Slabs | | |
| P/S Concrete Approach Slab | AREA | 320 |
| Reinforced Concrete Approach Slab | AREA | 321 |

AREA = square feet (square meter)

LENGTH= feet (meters)

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 = square feet (square meter)

### 2.2.3 Smart Flags (Defect 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 |

# 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.

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| **Description**<br>This element defines all reinforced concrete bridge deck/slab regardless of the wearing surface or protection systems used. | **Element # 12/38**<br>**Reinforced Concrete Deck/Slab**<br>**Square Feet (Square Meters)**<br>**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 and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Protect<br>Replace |

**Element Commentary**
The deck/slab evaluation is three dimensional in nature with the defects observed on top and/or bottom surface 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, non-destructive testing or indicators in the materials covering the surfaces.

**Element Definitions**

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

| **Element # 15**<br>**Prestressed \Reinforced Concrete Top Flange**<br>**Square Feet (Square Meters)**<br>**National Bridge Elements** | **Description**<br>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 and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Repair<br>Rehab<br>Replace |

**Element Commentary**

The flange evaluation is three dimensional in nature with the defects observed on top and/or bottom surface 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, non-destructive testing or indicators in the materials covering the surfaces.

**Element Definitions**

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

| | | | |
|---|---|---|---|
| | | leaching | |

| | |
|---|---|
| **Description**<br>This element defines all open grid steel bridge decks with no fill. | **Element #28**<br>**Steel Deck With Open Grid**<br>**Square Feet (Square Meters)**<br>**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
The deck evaluation is three dimensional in nature with the defects observed on top and/or bottom surface 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**<br>**Steel Deck with Concrete Filled Grid**<br>**Square Feet (Square Meters)**<br>**National Bridge Element** | **Description**<br>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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
The deck evaluation is three dimensional in nature with the defects observed on top and/or bottom surface 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** | **Element #30** |
|---|---|
| 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. | **Steel Deck Corrugated / Orthotropic / Etc.**<br>**Square Feet (Square Meters)**<br>**National Bridge Elements** |

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**

The deck evaluation is three dimensional in nature with the defects observed on top and/or bottom surface 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**<br>**Timber Deck / Slab**<br>**Square Feet (Square Meters)**<br>**National Bridge Elements** | **Description**<br>This element defines all timber bridge deck/slab regardless of the wearing surface or protection systems used |

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**

The deck/slab evaluation is three dimensional in nature with the defects observed on top and/or bottom surface 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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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 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 | 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. |

| | | | |
|---|---|---|---|
| | member. | | |

### 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 beam 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.

### 3.1.3 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.

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| **Description** | **Element #102** |
|---|---|
| This element defines all steel box girders or closed web girders. This element is for all box girders regardless of protective system. | **Steel Closed Web / Box Girder**<br>**Feet (Meters)**<br>**National Bridge Element** |

**Quantity Calculation**

The quantity for this element is the sum of all of the lengths of each box girder section. The quantity can be determined by counting the visible web faces and 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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Cracking/Fatigue | None | Arrested Cracks Exists | Moderate Cracks 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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**<br>**Prestressed Concrete Closed Web / Box Girder**<br>**Feet (Meters)**<br>**National Bridge Elements** | **Description**<br>This element defines pre-tensioned or post tensioned concrete closed web girder or box girder. This element is for all box girders regardless of protective system. |
|---|---|

**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 and 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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 filet should be considered with element 15.

**Element Definitions**

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

| **Description**<br>This element defines a reinforced concrete box girder or closed web girder. This element is for all box girders regardless of the protective system | **Element #105**<br>**Reinforced Concrete Closed Web / Box Girder**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**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 and 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 and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**

The box girder evaluation is three dimensional in nature with the defects observed include 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 filet should be considered with element 15.

**Element Definitions**

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

| **Element #107**<br>**Steel Open Girder / Beam**<br>**Feet (Meters)**<br>**National Bridge Elements** | **Description**<br>This element defines all steel open girders. This element is for all girders regardless of protective system. |
|---|---|

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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**<br>This element defines pre-tensioned or post tensioned concrete open web girders. This element is for all girders regardless of protective system. | **Element #109**<br>**Prestressed Concrete Girder / Beam**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 filet should be considered with element 15.

**Element Definitions**

| Defect | Hairline - Minor | Narrow-Moderate | Medium-Severe |
|---|---|---|---|
| Cracking | < 0.004 inches (0.1 mm) | 0.004 – 0.009 inches (0.1 – 0.23 mm) | >0.009 inches (0.23 mm) |
| Cracking Density | NA | 1.0 - 3.0 feet apart (0.33 – 1.0 m) | < 1 foot (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**<br>**Reinforced Concrete Girder / Beam**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines mild steel reinforced concrete open web girders. This element is for all girders regardless of protective system. |
|---|---|

**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 and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
If the riding surface is the exposed top surface, evaluation of the riding surface above the filet should be considered with element 15.

**Element Definitions**

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

| **Description**<br>This element defines all timber girders. This element is for all girders regardless of protection system. | **Element #111**<br>**Timber Open Girder**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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. |

### 3.1.4 Stringers

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

| **Description**<br>This element defines steel members that support the deck in a stringer floor beam system. This element is for all stringers regardless of protective system. | **Element #113**<br>**Steel Stringer**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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**<br>**Prestressed Concrete Stringer**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines pre-tensioned or post tensioned concrete members that support the deck in a stringer floor beam system. This element is for all stringers regardless of protective system. |
|---|---|

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 inches (0.1 mm) | 0.004 – 0.009 inches (0.1 – 0.23 mm) | >0.009 inches (0.23 mm) |
| Cracking Density | NA | 1.0 - 3.0 feet apart (0.33 – 1.0 m) | < 1 foot (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**<br>This element defines mild steel reinforced concrete members that support the deck in a stringer floor beam system. This element is for all stringers regardless of protective system. | **Element #116**<br>**Reinforced Concrete Stringer**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**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 and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| | |
|---|---|
| **Element #117**<br>**Timber Stringer**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines timber members that support the deck in a stringer floor beam system. This element is for all stringers regardless of protective system. |

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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 | 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. |

| | | | |
|---|---|---|---|
| | member. | | |

### 3.1.5 Trusses / Arches

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

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| **Description** | **Element #120**<br>**Steel Truss**<br>**Feet (Meters)**<br>**National Bridge Elements** |
|---|---|
| This element defines all steel truss elements. This includes all tension and compression members. This element includes through and deck trusses. This element is for all trusses regardless of protective system. | |

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Cracking/ Fatigue | None | Arrested Cracks Exist | Moderate Cracks Exists | |
| Connections | Sound | Sound | Isolated Failures | |
| Compression Members | No Out-Of-Plane Members | Arrested Out-Of-Plane Bending Exists | Out-Of-Plane Members Exists | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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**<br>**Timber Truss**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines all timber truss element. This includes all tension and compression members. This element includes through and deck trusses. This element is for all trusses regardless of protective system. |

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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**<br>This element defines steel arches regardless of type. This element is for all arches regardless of protective system. | **Element #141**<br>**Steel Arch**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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 Exists | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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**<br>**Prestressed Concrete Arch**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines only pre-tensioned or post tensioned concrete arches. This element is for all arches regardless of protective system. |
|---|---|

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| **Description**<br>This element defines only mild steel reinforced concrete arches. This element is for all arches regardless of protective system. | **Element #144**<br>**Reinforced Concrete Arch**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**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 and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| | |
|---|---|
| **Element #145**<br>**Masonry Arch**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines masonry or stacked stone arches. This element is for all arches regardless of protective system. |

**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 and/or moderate voids | Severe cracking or voids | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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 are 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Moderate | Severe |
|---|---|---|
| Cracking | 0.02– 0.08 inches (0.5 – 2.0 mm) | >0.08 inches (2.0 mm) |
| Cracking Density | 1.0 - 3.0 feet apart (0.33 – 1.0 m) | < 1 foot (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**<br>This element defines only timber arches. This element is for all arches regardless of protective system. | **Element #146**<br>**Timber Arch**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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. |

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### 3.1.6 Floor Beams

The elements are the intermediate transverse load carrying members. These elements can be constructed from steel, concrete and timber.

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| **Description**<br>This element defines only steel elements that support stringers. This element is for all floor beams regardless of protective system. | **Element #152**<br>**Steel Floor Beam**<br>**Feet (Meters)**<br>**National Bridge Elements** |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of all of the lengths of each floor beam.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Cracking/ Fatigue | None | Arrested Cracks Exist | Moderate Cracks 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**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 #154**<br>**Prestressed Concrete Floor Beam**<br>**Feet (Meters)**<br>**National Bridge Elements** | **Description**<br>This element defines only prestressed elements that support stringers. This element is for all floor beams regardless of protective system. |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of all of the lengths of each floor beam.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Exposed Rebar | None | None | Corrosion without section loss | |
| Exposed Prestressing | None | None | Present without 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| **Description**<br>This element defines only mild steel reinforced concrete elements that support stringers. This element is for all floor beams regardless of protective system. | **Element #155**<br>**Reinforced Concrete Floor Beam**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of all of the lengths of each floor beam.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Cracking | None to hairline | Narrow size and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| **Element #156**<br>**Timber Floor Beam**<br>**Feet (Meters)**<br>**National Bridge Elements** | **Description**<br>This element defines only timber superstructure elements that support stringers. This element is for all floor beams regardless of protective system. |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of all of the lengths of each floor beam.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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. |

### 3.1.7 Miscellaneous Superstructure Elements

Steel Pin, Pin Hanger Assemblies, Steel Gusset Plates and Cables will be discussed in this section.

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| **Description** | **Element #147** |
|---|---|
| This element defines all steel main suspension or cable stay cables not embedded in concrete. This element is for all cable groups regardless of protective systems. | **Steel Main Cables**<br>**Feet (Meters)**<br>**National Bridge Elements** |

**Quantity Calculation**
The quantity for this element is the sum of the length of the main cables.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Stands and Banding | Sound | Sound | Isolated Failures | |
| Anchors | 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
This element is intended for use on main cables in suspension bridges or main cable stays in cable stayed bridges. Suspender cables or other smaller cables shall be captured using the secondary cable element.

**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 |
|---|---|---|
| Anchors | Connections are in place and functioning as intended | Section loss, missing bolts / rivets, broken welds, or a severed connection. |

| | Sound | Isolated Failures |
|---|---|---|
| Strands and Banding | Cable strands and banding is in place and functioning as intended | Cables may have strand failures, section loss or similar distress. Areas of the banding have failed. |

| **Element #148**<br>**Secondary Steel Cables**<br>**Feet (Meters)**<br>**National Bridge Elements** | **Description**<br>This element defines all steel suspender cables or other secondary cables not embedded in concrete. This element is for all cable groups regardless of protective systems. |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of the length of the secondary steel cables.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Strands and Banding | Sound | Sound | Isolated Failures | |
| Anchors | 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
This element is intended for use on suspender cables or other smaller cables. Suspension bridge main cables or cable stays shall be captured using the steel main cable element.

**Element Definitions**

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

| | Sound | Isolated Failure |
|---|---|---|
| Anchors | Connections are in place and functioning as intended | Section loss, missing bolts / rivets, broken welds, or a severed connection. |

| | Sound | Isolated Failures |
|---|---|---|
| Strands and Banding | Cable strands and banding is in place and functioning as intended | Cables may have strand failures, section loss or similar distress. Areas of the banding have failed. |

| **Description**<br>This element defines steel pin and hanger assemblies. This element is for all assemblies regardless of protective system. | **Element #161**<br>**Steel Pin and/or Pin and Hanger Assembly**<br>**Each**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of the number of pin and hanger assemblies.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
Distress observed on either plate should be considered in the condition assessment. Ultrasonic testing results should be taken into consideration in the condition assessment if available.

**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 misalignment of the pins and hangers |

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

| **Element #162**<br>**Steel Gusset Plate**<br>**Each**<br>**National Bridge Element** | **Description**<br>This member defines only those steel gusset plate(s) connections that are on the main truss/arch panel(s). These connections can be constructed with one or more plates that may be bolted, riveted or welded. This element is for all gusset plates regardless of protective systems. |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of the number of primary load path gusset plate assemblies.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
For built up gusset plates, distress observed on any plate should be considered in the condition assessment. Non destructive testing results should be taken into consideration in the condition assessment if available.

**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, or broken welds |

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

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### 3.1.8 Substructure Elements

Substructure elements described in this section transmit the load from the superstructure into the ground. These elements include columns, piles, pile cap, pile extensions, caps, pier walls and abutments. These elements include elements of steel, concrete, timber, masonry and other materials.

### 3.1.9 Columns/Pile/Pier Wall

This section covers supporting elements the span of the structure. These items include columns pile extensions, piles and pier walls.

| **Description** | **Element #202** |
|---|---|
| This element defines only those steel columns or pile extensions. Piles exposed from erosion or included as part of the diver inspection are not included in this element. This element is for all columns/pile extensions regardless of protective system. | **Steel Column or Pile Extension**<br>**Each**<br>**National Bridge Element** |

**Quantity Calculation**
The quantity for this element is the sum of the number of columns or pile extensions.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Cracking/ Fatigue | None | Arrested Cracks Exist | Unarrested Cracks Exist | |
| Connections | Sound | Sound | Isolated Failures | |
| Scour | None | Arrestment And/ Or Countermeasures Exists | Minor | |
| Settlement | None | Arrestment And/ Or Countermeasures Exists | Minor | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

| | Freckled Rust | Section Loss |
|---|---|---|
| Corrosion | Corrosion of the steel has initiated | Steel pitting is evident without significant 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. |

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |

| | |
|---|---|
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| | |
|---|---|
| **Element #204**<br>**Prestressed Concrete Column or Pile Extension**<br>**Each**<br>**National Bridge Element** | **Description**<br>This element defines only those prestressed columns or pile extensions. Piles exposed from erosion or included as part of the diver inspection are not included in this element. This element is for all columns/pile extensions regardless of protective system. |

**Quantity Calculation**
The quantity for this element is the sum of the number of columns or pile extensions.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Exposed Rebar | None | None | Corrosion without section loss | |
| Exposed Prestressing | None | None | Present without Section Loss | |
| Cracks | Hairline Cracks Only | Narrow size or density | Medium size or density | |
| Efflorescence | None | Moderate but without rust | Severe with rust staining | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Description** | **Element #205** |
|---|---|
| This element defines only those reinforced columns or pile extensions. Piles exposed from erosion or included as part of the diver inspection are not included in this element. This element is for all columns/pile extensions regardless of protective system. | **Reinforced Concrete Column or Pile Extension**<br>**Each**<br>**National Bridge Element** |

**Quantity Calculation**

The quantity for this element is the sum of the number of columns or pile extensions.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Cracking | None to hairline | Narrow size and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |

| | |
|---|---|
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| | |
|---|---|
| **Element #206**<br>**Timber Column or Pile Extension**<br>**Each**<br>**National Bridge Elements** | **Description**<br>This element defines only those timber columns or pile extensions. Piles exposed from erosion or included as part of the diver inspection are not included in this element. This element is for all columns/pile extensions regardless of protective system. |

**Quantity Calculation**
The quantity of this element is the number of columns or pile extensions.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Checks/Shingles | Minor | Moderate | Severe | |
| Cracks | None | None | Minor | |
| Splits | Minor | Minor to Moderate | Minor to Moderate | |
| Abrasion | Minor | Minor | Moderate | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No reduction | No reduction | No reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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. |

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Description** | **Element #207**<br>**Steel Tower**<br>**Each**<br>**National Bridge Element** |
|---|---|
| This element defines only those steel built up or framed tower supports. This element is for all columns/pile extensions regardless of protective system. | |

**Quantity Calculation**

The quantity for this element is the sum of the number of built up or framed tower supports.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Cracking | None | Arrested Cracks Exist | Unarrested Cracks Exist | |
| Connections | Sound | Sound | Isolated Failures | |
| Scour | None | Arrestment And/ Or Countermeasures Exists | Minor | |
| Settlement | None | Arrestment And/ Or Countermeasures Exists | Minor | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**

This element is intended to be used for truss framed tower supports or built up steel towers. This element is intended to capture large supports and towers associated with suspension bridges, cable stayed bridges, moveable bridges or similar structural configurations.

**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 | Cracks with arrest holes, doubling plates or similar in place. | Identified cracks that are not arrested or otherwise addressed. |

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| | |
|---|---|
| **Element #208**<br>**Timber Trestle**<br>**Each**<br>**National Bridge Elements** | **Description**<br>This element defines only those framed timber supports. This element is for all timber trestle/towers regardless of protective system. |

**Quantity Calculation**
The quantity of this element is the number of framed timber trestles or towers.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Checks/Shingles | Minor | Moderate | Severe | |
| Cracks | None | None | Minor | |
| Splits | Minor | Minor to Moderate | Minor to Moderate | |
| Abrasion | Minor | Minor | Moderate | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No reduction | No reduction | No reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
This element is intended to be used for truss framed trestle or towers. This element is intended to capture large supports and towers associated with large deck truss bridges.

**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 and/or is in tension zones |
| Checks / Shingles | Surface level and does not penetrate more than 5% of the member thickness | Defect dose not penetrate more than 50% of the thickness of the member and/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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. |

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Description**<br>This element defines those reinforced concrete pier walls. This is for all pier walls regardless of protective systems. | **Element #210**<br>**Reinforced Concrete Pier Wall**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of the lengths of the pier walls measured along the skew angle.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Cracking | None to hairline | Narrow size and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| | |
|---|---|
| **Element #211**<br>**Other Pier Wall**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines those pier walls constructed of other materials. This is for all pier walls regardless of protective systems. |

**Quantity Calculation**
The quantity for this element is the sum of the lengths of the pier walls measured along the skew angle.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Condition | Good Condition | Fair Condition | Poor Condition | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Preserve | Do Nothing<br>Preserve<br>Repair | Do Nothing<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
This element should be used for materials not otherwise defined.

**Element Definitions**

| Defect | Good | Fair | Poor |
|---|---|---|---|
| Condition | No notable distress | Isolated breakdown or deterioration | Widespread deterioration or breakdown without reducing load capacity |

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Description**<br>This element defines those timber pier walls that include pile, timber sheet material and filler. This is for all pier walls regardless of protective systems. | **Element #212**<br>**Timber Pier Wall**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of the length of the pier walls measured along the skew angle

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Checks/Shingles | Minor | Moderate | Severe | |
| Cracks | None | None | Minor | |
| Splits | Minor | Minor to Moderate | Minor to Moderate | |
| Abrasion | Minor | Minor | Moderate | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No reduction | No reduction | No reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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. |

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |

| | |
|---|---|
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| | |
|---|---|
| **Element #213**<br>**Masonry Pier Wall**<br>**Feet (Meters)**<br>**National Bridge Elements** | **Description**<br>This element defines those pier walls constructed of block or stone. The block or stone may be placed with or without mortar. This is for all pier walls regardless of protective systems. |

**Quantity Calculation**
The quantity for this element is the sum of the wall lengths measured along the skew.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Mortar Breakdown | None | Cracking and/or moderate voids | Severe cracking or voids | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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 are 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Moderate | Severe |
|---|---|---|
| Cracking | 0.02– 0.08 inches (0.5 – 2.0 mm) | >0.08 inches (2.0 mm) |
| Cracking Density | 1.0 - 3.0 feet apart (0.33 – 1.0 m) | < 1 foot (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 |

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

### 3.1.10 Abutments

This section covers the abutments for the structure. The materials covered are steel, concrete, masonry, and other material abutments.

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| **Description**<br>This element defines reinforced concrete abutments. This includes the sheet material retaining the embankment and wing walls, abutment extensions, and any other monolithically placed concrete elements. This is for all abutments regardless of protective systems. | **Element #215**<br>**Reinforced Concrete Abutment**<br>**Feet (Meters)**<br>**National Bridge Elements** |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of the width of the abutment with wingwalls and abutment extensions.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Cracking | None to hairline | Narrow size and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| | |
|---|---|
| **Element #216**<br>**Timber Abutment**<br>**Feet (Meters)**<br>**National Bridge Elements** | **Description**<br>This element defines timber abutments. This includes the sheet material retaining the embankment, wing walls, and abutment extensions. This is for all abutments regardless of protective systems. |

**Quantity Calculation**

The quantity for this element is the sum of the width of the abutment with wingwalls and abutment extensions.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Checks/Shingles | Minor | Moderate | Severe | |
| Cracks | None | None | Minor | |
| Splits | Minor | Minor to Moderate | Minor to Moderate | |
| Abrasion | Minor | Minor | Moderate | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No reduction | No reduction | No reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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. |

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Description** | **Element #217** |
|---|---|
| This element defines those abutments constructed of block or stone. The block or stone may be placed with or without mortar. This is for all abutments regardless of protective systems. | **Masonry Abutment**<br>**Feet (Meters)**<br>**National Bridge Element** |

**Quantity Calculation**

The quantity for this element is the sum of the width of the abutment with wingwalls and abutment extensions.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Mortar Breakdown | None | Cracking and/or moderate voids | Severe cracking or voids | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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 are 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**

None

**Element Definitions**

| Defect | Moderate | Severe |
|---|---|---|
| Cracking | 0.02– 0.08 inches (0.5 – 2.0 mm) | >0.08 inches (2.0 mm) |
| Cracking Density | 1.0 - 3.0 feet apart (0.33 – 1.0 m) | < 1 foot (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 |

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| | |
|---|---|
| **Element #218**<br>**Other Abutments**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines other material abutments systems. This includes the sheet material retaining the embankment, wing walls, and abutment extensions. This is for all abutments regardless of protective systems. |

**Quantity Calculation**
The quantity of this element is the sum of the lengths of the abutments measured along the skew angle.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Condition | Good Condition | Fair Condition | Poor Condition | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Preserve | Do Nothing<br>Preserve<br>Repair | Do Nothing<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
This element should be used for materials not otherwise defined.

**Element Definitions**

| Defect | Good | Fair | Poor |
|---|---|---|---|
| Condition | No notable distress | Isolated breakdown or deterioration | Widespread deterioration or breakdown without reducing load capacity |

| Defect | Minor |
|---|---|
| Scour | Scour is beginning but no noticeable hole has developed |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Description** | **Element #219**<br>**Steel Abutment**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|
| This element defines steel abutments. This includes the sheet material retaining the embankment, wing walls, and abutment extensions. This is for all abutments regardless of protective systems. | |

**Quantity Calculation**
The quantity of this element is the sum of width of the abutment with wingwalls and abutment extensions.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Cracking/ Fatigue | None | Arrested Cracks Exist | Moderate Cracks Exists | |
| Connections | Sound | Sound | Isolated Failures | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

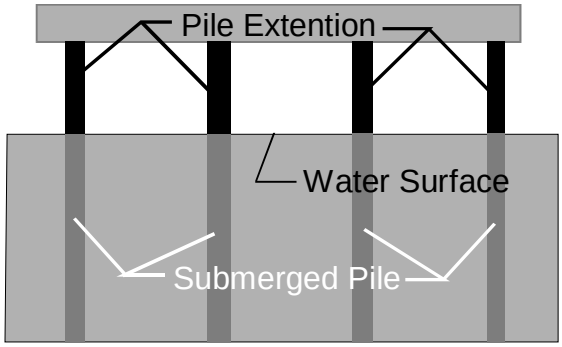
| | Sound | Isolated Failure |
|---|---|---|
| Connections | Connections are in place and functioning as intended | Missing bolts/rivets, broken welds or a severed connection. |

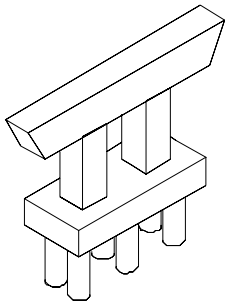
| | Arrested | Moderate |
|---|---|---|
| Cracking/ Fatigue | Cracks with arrest holes, doubling plates or similar in place. | Identified cracks that are not arrested or otherwise addressed. |

| Defect | Minor |
|---|---|
| Scour | Scour exists - the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

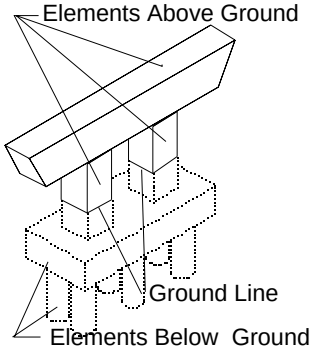
### 3.1.11 Submerged Pile/Caps/Footings

Submerged elements are defined as only those elements that are continuously submerged and are visible for inspection.

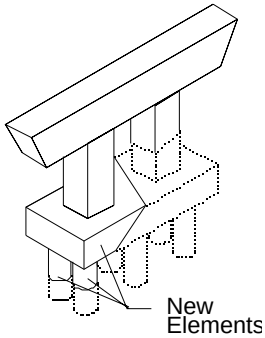


**Designed Configuration of the Bent**




**Bent after Construction and in Service**




**Bent after Scour**

**New Elements are 2 Submerged Piles, Submerged Pile Cap**

| **Description**<br>This element defines only those reinforced concrete piles that are typically submerged in water and are visible for inspection. The exposure may be intentional or caused by erosion. | **Element #220**<br>**Reinforced Concrete Submerged Pile Cap / Footing**<br>**Each**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**
The quantity of this element is the sum of the number of footings or pile caps.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Cracking | None to hairline | Narrow size and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| | |
|---|---|
| **Element #225**<br>**Steel Submerged Pile**<br>**Each**<br>**National Bridge Element** | **Description**<br>This element defines only those steel piles that are continuously submerged in water and are visible for inspection. Piles exposed from erosion or are part of the diver inspection are included in this element. This element is for all pile extensions regardless of protective system. |

**Quantity Calculation**
The quantity for this element is the sum of the number of submerged piles.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Cracking/ Fatigue | None | Arrested Cracks Exist | Moderate Cracks Exists | |
| Connections | Sound | Sound | Isolated Failures | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**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. |

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Description** | **Element #226**<br>**Prestressed Concrete Submerged Pile**<br>**Each**<br>**National Bridge Element** |
|---|---|
| This element defines only those prestressed piles that are continuously submerged in water and are visible for inspection. Piles exposed from erosion or are part of the diver inspection are included in this element. This element is for all columns/pile extensions regardless of protective system. | |

**Quantity Calculation**

The quantity for this element is the sum of the number of submerged piles.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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 | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**

None

**Element Definitions**

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

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Element #227**<br>**Reinforced Concrete Submerged Pile**<br>**Each**<br>**National Bridge Element** | **Description**<br>This element defines only those reinforced concrete piles that are typically submerged in water and are visible for inspection. Piles exposed from erosion or are part of the diver inspection are included in this element. This element is for all columns/pile extensions regardless of protective system. |
|---|---|

### Quantity Calculation
The quantity for this element is the sum of the number of submerged piles.

### Condition State Definitions

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Cracking | None to hairline | Narrow size and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Spalls / Delaminations/ Patched Areas | None | Moderate spall or patch areas that are sound | Severe spall or patched area showing distress | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

### Element Commentary
None

### Element Definitions

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

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Description** | **Element #228**<br>**Timber Submerged Pile**<br>**Each**<br>**National Bridge Element** |
|---|---|
| This element defines only those timber piles that are typically submerged in water and are visible for inspection. Piles exposed from erosion or are part of the diver inspection are included in this element. This element is for all columns/pile extensions regardless of protective system. | |

**Quantity Calculation**

The quantity for this element is the sum of the number of submerged piles.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Checks/Shingles | Minor | Moderate | Severe | |
| Cracks | None | None | Minor | |
| Splits | Minor | Minor to Moderate | Minor to Moderate | |
| Abrasion | Minor | Minor | Moderate | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No reduction | No reduction | No reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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. |

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Element #231**<br>**Steel Pier Cap**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines those steel pier caps that support girders and transfer load into piles. This element is for all steel pier caps regardless of protective system. |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of the cap lengths measured along the skew angle.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Cracking/ Fatigue | None | Arrested Cracks Exist | Moderate Cracks 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**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**<br>This element defines those prestressed concrete pier caps that support girders and transfer load into piles. This element is for all caps regardless of protective system. | **Element #233**<br>**Prestressed Concrete Cap**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of the cap lengths measured along the skew angle.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Exposed Rebar | None | None | Corrosion without section loss | |
| Exposed Prestressing | None | None | Present without 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| **Element #234**<br>**Reinforced Concrete Pier Cap**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines those reinforced concrete caps that support girders and transfer load into piles. This element is for all pier caps regardless of protective system. |
|---|---|

**Quantity Calculation**
The quantity for this element is the sum of the cap length measured along the skew angle.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Cracking | None to hairline | Narrow size and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| **Description** | **Element #235**<br>**Timber Pier Cap**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|
| This element defines those timber caps that support girders that transfer load into piles. This element is for all timber pier caps regardless of protective system. | |

**Quantity Calculation**
The quantity for this element is the sum of the pier cap lengths measured along the skew angle.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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. |

### 3.1.12 Culverts

This section covers steel, reinforced concrete, timber, masonry and other types of culverts.

| **Description**<br>This element defines steel culverts, including arched, round or elliptical pipes. | **Element #240**<br>**Steel Culvert**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**
The quantity for this element is the flow line length of the barrel times the number of barrels.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Cracking/ Fatigue | None | Arrested Cracks Exist | Moderate Cracks Exist | |
| Connections | Sound | Sound | Isolated Failures | |
| Seams | Sound | Sound | Localized Failure | |
| Distortion | None | None | Tolerable without reducing load capacity | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
The distortion defect is contingent on a number of factors such as site, wall thickness, fill depth, etc. The inspector shall use such factors to assess the proper condition state.

**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. |

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Element #241**<br>**Reinforced Concrete Culvert**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines reinforced concrete culverts, including box, arched, round or elliptical shapes. |
|---|---|

**Quantity Calculation**
The quantity for this element is the flow line length of the barrel times the number of the barrels.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Cracking | None to hairline | Narrow size and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Spalls / Delaminations/ Patched Areas | None | Moderate spall or patch areas that are sound | Severe spall or patched area showing distress | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
The distortion defect is contingent on a number of factors such as site, wall thickness, fill depth, etc. The inspector shall use such factors to assess the proper condition state.

**Element Definitions**

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

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |

| | |
|---|---|
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| | |
|---|---|
| **Description**<br>This element defines all timber culverts regardless of the protection systems used. | **Element #242**<br>**Timber Culvert**<br>**Feet (Meters)**<br>**National Bridge Element** |

**Quantity Calculation**

The quantity of this element is the flow line length of the barrel times the number of barrels.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Checks/Shingles | Minor | Moderate | Severe | |
| Cracks | None | None | Minor | |
| Splits | Minor | Minor to Moderate | Minor to Moderate | |
| Abrasion | Minor | Minor | Moderate | |
| Distortion | None | None | Tolerable without reducing load capacity | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No reduction | No reduction | No reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**

The distortion defect is contingent on a number of factors such as site, wall thickness, fill depth, etc. The inspector shall use such factors to assess the proper condition state.

**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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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. |

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |

| | |
|---|---|
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| | |
|---|---|
| **Element #243**<br>**Other Culvert**<br>**Feet (Meters)**<br>**National Bridge Element** | **Description**<br>This element defines other material type culverts, including arches, round or elliptical pipes. These culverts are not included in steel, concrete or timber material types. |

**Quantity Calculation**
The quantity of this element is the flow line length of the barrel times the number of barrels.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Condition | Good Condition | Fair Condition | Poor Condition | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Preserve | Do Nothing<br>Preserve<br>Repair | Do Nothing<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
The distortion defect is contingent on a number of factors such as site, wall thickness, fill depth, etc. The inspector shall use such factors to assess the proper condition state.

**Element Definitions**

| Defect | Good | Fair | Poor |
|---|---|---|---|
| Condition | No notable distress | Isolated breakdown or deterioration | Widespread deterioration or breakdown without reducing load capacity |

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

| **Description**<br>This element defines masonry block or stone culverts. | **Element #244**<br>**Masonry Culvert**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**
The quantity for this element is the flow line length of the barrel times the number of barrels.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Mortar Breakdown | None | Cracking and/or moderate voids | Severe cracking or voids | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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 are cracked with masonry face deformation. Block or stone are missing | |
| Efflorescence | None | Moderate but without rust | Severe with rust staining | |
| Scour | None | Arrestment and/or Countermeasures exists | Minor | |
| Settlement | None | Arrestment and/or Countermeasures exists | Minor | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
The distortion defect is contingent on a number of factors such as site, wall thickness, fill depth, etc. The inspector shall use such factors to assess the proper condition state.

**Element Definitions**

| Defect | Moderate | Severe |
|---|---|---|
| Cracking | 0.02– 0.08 inches (0.5 – 2.0 mm) | >0.08 inches (2.0 mm) |
| Cracking Density | 1.0 - 3.0 feet apart (0.33 – 1.0 m) | < 1 foot (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 |

| Defect | Minor |
|---|---|
| Scour | Scour exists – the structure remains stable |
| Settlement | Measurable settlement has occurred but not impacting load capacity |

### 3.1.13 Bearings

This section covers fixed, movable and specialty bearing.

| **Description**<br>This element defines only those bridge bearings that are constructed primarily of elastomers, with or without fabric or metal reinforcement. | **Element #310**<br>**Elastomeric Bearing**<br>**Each (Each)**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**
The quantity is the sum of each bearing of this type.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Movement | Free to Move | Minor Restriction | Restricted | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Alignment | Good | Tolerable | Approaching Limits | |
| Condition | No bulging, splitting or tearing | Minor Bulging, splitting or tearing | Moderate bulging, splitting or tearing | |
| Capacity | No Reduction | No Reduction | Some Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Minor | Moderate | Severe |
|---|---|---|---|
| Alignment | Minor lateral or vertical alignment changes are present. | The lateral or vertical alignment is noticeable and approaching the limits of the bearing. | Alignment changes have resulted in bearings that are no longer capable of carrying load or are causing damage to supporting material. |

| **Element #311**<br>**Moveable Bearing**<br>**Each (Each)**<br>**National Bridge Element** | **Description**<br>This element defines only those bridge bearings which provide for both rotation and longitudinal movement by means of roller, rocker, or sliding mechanisms. |
|---|---|

**Quantity Calculation**
The quantity is the sum of each bearing of this type.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Movement | Free to Move | Minor Restriction | Restricted | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Alignment | Good | Tolerable | Approaching Limits | |
| Condition | No corrosion | Early corrosion | Early section loss | |
| Capacity | No Reduction | No Reduction | Some Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Reset | Do Nothing<br>Reset<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Tolerable | Approaching Limits | Beyond Limits |
|---|---|---|---|
| Alignment | Minor lateral or vertical alignment changes are present. | The lateral or vertical alignment is noticeable and approaching the limits of the bearing. | Alignment changes have resulted in bearings that are no longer capable of carrying load or are causing damage to supporting material. |

| **Description**<br>This element defines only those bridge bearings that are enclosed so that they are not open for detailed inspection. | **Element #312**<br>**Enclosed/Concealed Bearing**<br>**Each (Each)**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**
The quantity is the sum of each bearing of this type.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Movement | Free to Move | Minor Restriction | Restricted | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Alignment | Good | Tolerable | Approaching Limits | |
| Condition | No Deterioration | Minor Deterioration | Moderate Deterioration | |
| Capacity | No Reduction | No Reduction | Some Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
This element should be used for box girder hinges. In cases where the bearing material is not visible, the inspector shall assess the condition based on alignment, grade across the joint, persistence of debris or other indirect indicators of the condition.

**Element Definitions**

| Defect | Tolerable | Approaching Limits | Beyond Limits |
|---|---|---|---|
| Alignment | Minor lateral or vertical alignment changes are present. | The lateral or vertical alignment is noticeable and approaching the limits of the bearing. | Alignment changes have resulted in bearings that are no longer capable of carrying load or are causing damage to supporting material. |

| **Element #313**<br>**Fixed Bearing**<br>**Each (Each)**<br>**National Bridge Element** | **Description**<br>This element defines only those bridge bearings that provide for rotation only (no longitudinal movement). |
|---|---|

**Quantity Calculation**
The quantity is the sum of each bearing of this type.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Alignment | Good | Tolerable | Approaching Limits | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Condition | No corrosion | Early corrosion | Early section loss | |
| Capacity | No Reduction | No Reduction | Some Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Reset | Do Nothing<br>Reset<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Tolerable | Approaching Limits | Beyond Limits |
|---|---|---|---|
| Alignment | Minor lateral or vertical alignment changes are present. | The lateral or vertical alignment is noticeable and approaching the limits of the bearing. | Alignment changes have resulted in bearings that are no longer capable of carrying load or are causing damage to supporting material. |

| **Description** | **Element #314** |
|---|---|
| This element defines those high load bearings with confined elastomer. The bearing may be fixed against horizontal movement, guided to allow sliding in one direction, or floating to allow sliding in any direction. | **Pot Bearing**<br>**Each (Each)**<br>**National Bridge Element** |

**Quantity Calculation**
The quantity is the sum of each bearing of this type.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Movement | Free to Move | Minor Restriction | Restricted | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Alignment | Good | Tolerable | Approaching Limits | |
| Condition | No Deterioration | Minor Deterioration | Moderate Deterioration | |
| Capacity | No Reduction | No Reduction | Some Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Tolerable | Approaching Limits | Beyond Limits |
|---|---|---|---|
| Alignment | Minor lateral or vertical alignment changes are present. | The lateral or vertical alignment is noticeable and approaching the limits of the bearing. | Alignment changes have resulted in bearings that are no longer capable of carrying load or are causing damage to supporting material. |

| | |
|---|---|
| **Element #315**<br>**Disc Bearing**<br>**Each (Each)**<br>**National Bridge Element** | **Description**<br>This element defines those high load bearings with a hard plastic disk. This bearing may be fixed against horizontal movement, guided to allow movement in one direction, or floating to allow sliding in any direction. |

**Quantity Calculation**
The quantity is the sum of each bearing of this type.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Movement | Free to Move | Minor Restriction | Restricted | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Alignment | Good | Tolerable | Approaching Limits | |
| Condition | No Deterioration | Minor Deterioration | Moderate Deterioration | |
| Capacity | No Reduction | No Reduction | Some Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Tolerable | Approaching Limits | Beyond Limits |
|---|---|---|---|
| Alignment | Minor lateral or vertical alignment changes are present. | The lateral or vertical alignment is noticeable and approaching the limits of the bearing. | Alignment changes have resulted in bearings that are no longer capable of carrying load or are causing damage to supporting material. |

### 3.1.14 Bridge Rail

This section covers bridge rail. These bridge rails can be comprised of steel, concrete, masonry and other materials.

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| **Description** | **Element # 330** |
|---|---|
| This element defines all types and shapes of metal bridge railing. Steel, aluminum, metal beam, rolled shapes, etc. will all be considered part of this element. Included in this element are the posts of metal, timber or concrete, blocking and curb. | **Metal Bridge Railing**<br>**Feet(Meters)**<br>**National Bridge Element** |

**Quantity Calculation**
Quantity is the number of rows of rail times the length of the bridge. The element quantity includes the rail on the bridge.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Connections | Sound | Loose | Loose or Missing Fasteners | |
| Post | Sound | Misaligned | Section Loss | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Repair<br>Replace |

**Element Commentary**
None

**Element Definitions**

| | Sound | Isolated Failure |
|---|---|---|
| Connections | All connectors are in place and functioning | Connectors are loose, or broken |

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

| | |
|---|---|
| **Element # 331**<br>**Reinforced Concrete Bridge Railing**<br>**Feet(Meters)**<br>**National Bridge Element** | **Description**<br>This element defines all types and shapes of reinforced concrete bridge railing. All elements of the railing must be concrete. |

**Quantity Calculation**
Quantity is the number of rows of rail times the length of the bridge. The element quantity includes the rail on the bridge.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Cracking | None to hairline | Narrow size and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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 | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Repair<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

| **Description**<br>This element defines all types and shapes of timber bridge railing. Included in this element are the posts of timber, metal or concrete, blocking and curb. | **Element # 332**<br>**Timber Bridge Railing**<br>**Feet (Meters)**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**
Quantity is the number of rows of rail times the length of the bridge. The element quantity includes the rail on the bridge.

**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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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 | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Repair<br>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 and/or is in tension zones |
| 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/or in the areas of neutral axis | Defect penetrating more that 50% of the thickness of the member and/or in areas of the tension zone. |
| 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. |

| **Element # 333**<br>**Other Bridge Railing**<br>**Feet(Meters)**<br>**Bridge Management Element** | **Description**<br>This element defines all types and shapes of bridge railing except those defined as metal, concrete, timber or masonry. |
|---|---|

**Quantity Calculation**
Quantity is the number of rows of rail times the length of the bridge. The element quantity includes the rail on the bridge.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Condition | Good Condition | Fair Condition | Poor Condition | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Preserve | Do Nothing<br>Preserve<br>Repair | Do Nothing<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
This element should be used for materials not otherwise defined or combinations of materials

**Element Definitions**

| Defect | Good | Fair | Poor |
|---|---|---|---|
| Condition | No notable distress | Isolated breakdown or deterioration | Widespread deterioration or breakdown without reducing load capacity |

| **Description**<br>This element defines all types and shapes of masonry block or stone bridge railing. All elements of the railing must be masonry block or stone. | **Element # 334**<br>**Masonry Bridge Railing**<br>**Feet(Meters)**<br>**National Bridge Element** |
|---|---|

**Quantity Calculation**

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Mortar Breakdown | None | Cracking and/or moderate voids | Severe cracking or voids | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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 are 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<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Shrinkage | Moderate | Severe |
|---|---|---|---|
| Cracking | < 0.005 inches (0.1 mm) | 0.02– 0.08 inches (0.5 – 2.0 mm) | >0.08 inches (2.0 mm) |
| Cracking Density | N/A | 1.0 - 3.0 feet apart (0.33 – 1.0 m) | < 1 foot (0.33 m) |
| Mortar Breakdown | N/A | Cracking or voids in less than 10% of joints | Cracking or voids in more than 10% of joints |
| Efflorescence | N/A | Surface white without build-up or leaching | Heavy build-up with rust staining |

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## 3.2 Bridge Management Elements

This section describes in detail those other structure elements that agencies have collected to support their Bridge Management System. These elements are defined in fairly generic terms that can be refined by the agency to suit their desired business practices. Agencies can develop additional BME's as necessary following the agency developed element conventions. When considering additional elements, the agency should consider such factors as element performance, deterioration rates, feasible actions and preservation costs. Appendix A contains guidance on developing elements to facilitate an agency's business practice.

### 3.2.1 Joints

This section covers expansion joints, pourable joints, compression joins, and assembly joints

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| **Description**<br>This element defines those expansion joint devices which utilize a neoprene type waterproof gland with some type of metal extrusion or other system to anchor the gland. | **Element #300**<br>**Strip Seal Expansion Joint**<br>**Feet (Meters)**<br>**Bridge Management Element** |
|---|---|

**Quantity Calculation**
The quantity for this element is determined by summing all the lengths of the joint measured along the skew angle.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Leakage | None | Minimal | Moderate | Extensive |
| Adhesion | Good | Substantially Adhered | Limited Adhesion | Minimal Adhesion |
| Gland Damage | None | Minor Damage | Punctured, ripped or partially pulled out | Missing sections or completely removed |
| Debris Impaction | No Significant | Minor | Moderate | Severe |
| Adjacent Deck or Header | Sound, no spalls | Sound, minor delaminations or spalls | Loose with delaminations and/or spalls | Unsound, no longer effective |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Repair<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Minor | Moderate | Severe |
|---|---|---|---|
| Gland Damage | Punctured or ripped or partially pulled out of the extrusion | Punctured or ripped or partially pulled out of the extrusion | Failed from abrasion or tearing and has pulled out of the extrusion |
| Debris Impaction | A minor amount of fine material still allowing the joint to move | A moderate amount of debris would restrict joint movement in local areas | Heavy impaction with debris effectively looking the joint. |
| Adjacent Damage | Small joint edge spalls or delaminations | Larger spalling or deeper local spalling or delaminations | Heavy deep spalling or delaminations to the depth of the joint anchors. |

| | |
|---|---|
| **Element #301**<br>**Pourable Joint Seal**<br>**Feet (Meters)**<br>**Bridge Management Element** | **Description**<br>This Element defines on those joints filled with a pourable seal with or without a backer. |

**Quantity Calculation**
The quantity for this element is determined by summing all the lengths of the joint measured along the skew angle.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Leakage | None | Minimal | Moderate | Extensive |
| Adhesion | Good | Substantially Adhered | Limited Adhesion | Minimal Adhesion |
| Cohesion | None | Minor Cracking | Moderate Cracking | Severe Cracking |
| Debris Impaction | No Significant | Minor | Moderate | Severe |
| Adjacent Deck or Header | Sound, no spalls | Sound, minor delaminations or spalls | Loose with delaminations and/or spalls | Unsound, no longer effective |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Repair<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Minor | Moderate | Severe |
|---|---|---|---|
| Debris Impaction | A minor amount of fine material still allowing the joint to move | A moderate amount of debris would restrict joint movement in local areas | Heavy impaction with debris effectively looking the joint. |
| Adjacent Damage | Small joint edge spalls or delaminations | Larger spalling or deeper local spalling or delaminations | Heavy deep spalling or delaminations to the depth of the joint anchors. |
| Cohesion | Small Isolated cracks | Wider cracks or multiple cracks in the same length | Numerous cracks or extremely wide cracking in the same length |

| **Description**<br>This element defines only those joints filled with a pre-formed compression type seal. This joint does not have an anchor system to confine the seal. | **Element #302**<br>**Compression Joint Seal**<br>**Feet (Meters)**<br>**Bridge Management Element** |
|---|---|

**Quantity Calculation**
The quantity for this element is determined by summing all the lengths of the joint measured along the skew angle.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Leakage | None | Minimal | Moderate | Extensive |
| Adhesion | Good | Substantially Adhered | Limited Adhesion | Minimal Adhesion |
| Gland Damage | None | Minor Damage | Punctured, ripped or partially pulled out | Missing sections or completely removed |
| Debris Impaction | No Significant | Minor | Moderate | Severe |
| Adjacent Deck or Header | Sound, no spalls | Sound, minor delaminations or spalls | Loose with delaminations and/or spalls | Unsound, no longer effective |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Repair<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Minor | Moderate | Severe |
|---|---|---|---|
| Gland Damage | Punctured or ripped or partially pulled out of the extrusion | Punctured or ripped or partially pulled out of the extrusion | Failed from abrasion or tearing and has pulled out of the extrusion |
| Debris Impaction | A minor amount of fine material still allowing the joint to move | A moderate amount of debris would restrict joint movement in local areas | Heavy impaction with debris effectively looking the joint. |
| Adjacent Deck Damage | Small joint edge spalls or delaminations | Larger spalling or deeper local spalling, delaminations or loose amour | Heavy deep spalling or delaminations, unattached armor. |

| **Element #303**<br>**Assembly Joint With Seal**<br>**Feet (Meters)**<br>**Bridge Management Element** | **Description**<br>This element defines only those joints filled with an assembly mechanism that have a seal. |
|---|---|

**Quantity Calculation**
The quantity for this element is determined by summing all the lengths of the joint measured along the skew angle.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Leakage | None | Minimal | Moderate | Extensive |
| Adhesion | Good | Substantially Adhered | Limited Adhesion | Minimal Adhesion |
| Gland Damage | None | Minor Damage | Punctured, ripped or partially pulled out | Missing sections or completely removed |
| Metal Damage | None | Minor Damage | Isolated Metal Cracking or Broken Connections | Extensive Metal Cracking or Connection Failures. |
| Debris Impaction | No Significant | Minor | Moderate | Severe |
| Adjacent Deck or Header | Sound, no spalls | Sound, minor delaminations or spalls | Loose with delaminations and/or spalls | Unsound, no longer effective |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Repair<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Minor | Moderate | Severe |
|---|---|---|---|
| Gland Damage | Punctured or scraped | Punctured or ripped or partially pulled out of the extrusion | Failed from abrasion or tearing and has pulled out of the extrusion |
| Debris Impaction | A minor amount of fine material still allowing the joint to move | A moderate amount of debris would restrict joint movement in local areas | Heavy impaction with debris effectively looking the joint. |
| Adjacent Damage | Small joint edge spalls or delaminations | Larger spalling or deeper local spalling or delaminations | Heavy deep spalling or delaminations to the depth of the joint anchors. |

| **Description**<br>This element defines only those joints that are open and not sealed. | **Element #304**<br>**Open Expansion Joint**<br>**Feet (Meters)**<br>**Bridge Management Element** |
|---|---|

**Quantity Calculation**
The quantity for this element is determined by summing all the lengths of the joint measured along the skew angle.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Debris Impaction | No Significant | Minor | Moderate | Severe |
| Adjacent Deck or Header | Sound, no spalls | Sound, minor delaminations or spalls | Loose with delaminations and/or spalls | Unsound, no longer effective |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Repair<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Minor | Moderate | Severe |
|---|---|---|---|
| Debris Impaction | A minor amount of fine material still allowing the joint to move | A moderate amount of debris would restrict joint movement in local areas | Heavy impaction with debris effectively looking the joint. |
| Adjacent Damage | Small joint edge spalls or delaminations | Larger spalling or deeper local spalling or delaminations | Heavy deep spalling or delaminations to the depth of the joint anchors. |

| | |
|---|---|
| **Element #305**<br>**Assembly Joint Without Seal**<br>**Feet (Meters)**<br>**Bridge Management Element** | **Description**<br>This element defines only those assembly joints that are open and not sealed. These joint includes finger and sliding plate joints. |

**Quantity Calculation**
The quantity for this element is determined by summing all the lengths of the joint measured along the skew angle.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Leakage | None | Minimal | Moderate | Extensive |
| Adhesion | Good | Substantially Adhered | Limited Adhesion | Minimal Adhesion |
| Gland Damage | None | Minor Damage | Punctured, ripped or partially pulled out | Missing sections or completely removed |
| Metal Damage | None | Minor Damage | Isolated Metal Cracking or Broken Connections | Extensive Metal Cracking or Connection Failures. |
| Debris Impaction | No Significant | Minor | Moderate | Severe |
| Adjacent Deck or Header | Sound, no spalls | Sound, minor delaminations or spalls | Loose with delaminations and/or spalls | Unsound, no longer effective |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Repair<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Minor | Moderate | Severe |
|---|---|---|---|
| Debris Impaction | A minor amount of fine material still allowing the joint to move | A moderate amount of debris would restrict joint movement in local areas | Heavy impaction with debris effectively looking the joint. |
| Adjacent Damage | Small joint edge spalls or delaminations | Larger spalling or deeper local spalling or delaminations | Heavy deep spalling or delaminations to the depth of the joint anchors. |

### 3.2.2 Approach Slabs

This section will cover bridge approach slabs. These slabs will be constructed with concrete and mild or prestress (post tension) reinforcement.

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| **Description**<br>This element defines those structural sections, between the abutment and the approach pavement that are constructed of prestressed (post tensioned) reinforced concrete. | **Element # 320**<br>**Prestress Concrete Approach Slab**<br>**Square Feet(Square Meters)**<br>**Bridge Management 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 |
|---|---|---|---|---|
| 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) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| Exposed Rebar | None | None | Corrosion without section loss | |
| Exposed Prestressing | None | None | Present without section loss | |
| Cracks | Hairline Cracks Only | Narrow size or density | Medium size or density | |
| Efflorescence | None | Moderate but without rust | Severe with rust staining | |
| Settlement | None | Less than 1.5 inch (40 mm) | More than 1.5 inch (40 mm) | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Hairline - Minor | Narrow-Moderate | Medium-Severe |
|---|---|---|---|
| Cracking | < 0.005 inches (0.1 mm) | 0.02– 0.08 inches (0.5 – 2.0 mm) | >0.08 inches (2.0 mm) |
| Cracking Density | NA | 1.0 - 3.0 feet apart (0.33 – 1.0 m) | < 1 foot (0.33 m) |
| Efflorescence | N/A | Surface white without build-up or leaching | Heavy build-up with rust staining |
| Spalls/ Delaminations | N/A | Spall less than 1 inch (25 mm) deep or less than 6 inches in diameter | Spall greater than 1 inch (25 mm) deep or greater than 6 inches in diameter or exposed rebar |

| **Element # 321**<br>**Reinforced Concrete Approach Slab**<br>**Square Feet(Square Meters)**<br>**Bridge Management Element** | **Description**<br>This Element defines those structural sections, between the abutment and the approach pavement that are constructed of mild steel reinforced concrete. |
|---|---|

**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 minor | Narrow size and/or density | Medium size and/or density | The condition is beyond the limits established in condition state three (3) and/or warrants a structural review to determine the strength or serviceability of the element or bridge. |
| 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 | |
| Settlement | None | Less than 1.5 inch (40 mm) | More than 1.5 inch (40 mm) | |
| Load Capacity | No reduction | No reduction | No reduction | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

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

### 3.2.3 Smart Flags (Defect Flags)

This section will cover the smart flags and their use. Each flag will be associated with an element and will define the predominate defect for that condition state.

[BLANK PAGE]

| | | | Flag Application | | | |
|---|---|---|---|---|---|---|
| Flag No. | Flag Name | Flag Description | Deck | Super | Sub | Culvert |
| 356 | Steel Cracking/Fatigue | This flag shall be used with steel elements to identify the predominate defect in a given condition state that is not corrosion. | X | X | X | X |
| 357 | Pack Rust | This flag shall be used in conjunction with steel elements connection defects (including shapes in contact in built-up members) of steel bridges that are already showing signs of rust packing between plates. | X | X | X | X |
| 358 | Concrete Cracking | This flag shall be used with concrete elements to identify the predominate defect in a given condition state that is not spalling or delaminations. | X | X | X | X |
| 359 | Concrete Efflorescence | This flag shall be used with concrete elements to identify the predominate defect in a given condition state that is not spalling or delaminations. | X | X | X | X |
| 360 | Settlement | This flag shall be used with all substructure and culvert elements to identify the predominate defect in a given condition state is not material deterioration. The use of the flag is to identify the severity of the settlement. | | | X | X |
| 361 | Scour | This flag shall be used with all substructure and culvert elements to identify the predominate defect in a given condition state that is not material deterioration. The use of the flag is to identify the severity of the scour. | | | X | X |
| 362 | Superstructure Traffic Impact | This flag shall identify all traffic collisions with the superstructure. Application of the flag in relation to the impact on the structures capacity to carry load. | | X | | |
| 363 | Steel Section Loss | This flag shall be used with steel elements to identify the predominate defect in a given condition state that is not corrosion. Setting this flag will identify the severity of section loss | X | X | X | X |

| | | | Flag Application | | | |
|---|---|---|---|---|---|---|
| Flag No. | Flag Name | Flag Description | Deck | Super | Sub | Culvert |
| 364 | Steel Out-of-plane Compression Members | This element shall be used with steel truss or arch elements. The use of the flag shall denote any member that is not in plane with the panel (buckling). It shall be used to identify the predominate defect in a given condition state that is not material deterioration. | | X | | |
| 366 | Deck Traffic Impact | This flag shall identify all traffic collisions with the deck. Application of the flag in relation to the impact on the structures capacity to carry load. | X | | | |
| 367 | Substructure Traffic Impact | This flag shall identify all traffic collisions with the substructure. Application of the flag in relation to the impact on the structures capacity to carry load. | | | X | |
| 368 | Barrel Distortion | This flag is to identify the severity of the culvert barrel distortion. Its use shall be with culverts only. This flag shall describe predominate culvert deterioration that is not attributed to material deterioration. | | | | X |

### 3.2.4 Protective Systems

The elements in this section are protective systems types. These systems will influence the deterioration and condition of the underlying structural element. The general categories are wearing surfaces and protective coatings.

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| **Description**<br>This element is for all decks/slabs that have overlays made with flexible (asphaltic concrete), semi rigid (epoxy and polyester material) or rigid (portland cement) materials. | **Element #510**<br>**Wearing Surfaces**<br>**Square Feet(Square Meters)**<br>**Bridge Management 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 |
|---|---|---|---|---|
| Spalls/ Delaminations/ Patch Areas/ Potholes | None | Moderate | Severe | The wearing surface is no longer effective. |
| Cracks | Shrinkage Only | Narrow size or density | Medium size or density | |
| Effectiveness | Good condition, fully effective | Fair condition, substantially effective | Poor condition, limited effectiveness | |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Minor | Moderate | Severe |
|---|---|---|---|
| Cracking | < 0.02 inches (0.5 mm) | 0.02 – 0.08 inches (0.5 – 2.0 mm) | >0.08 inches (2.0 mm) |
| Cracking Density | N/A | 1.0 - 3.0 feet apart (0.33 – 1.0 m) | < 1 foot (0.33 m) |

| **Element # 515**<br>**Steel Protective Coating**<br>**Square Feet(Square Meters)**<br>**Bridge Management Element** | **Description**<br>The element is for steel elements that have a protective coating such as paint, galvanization or other top coat steel corrosion inhibitor. |
|---|---|

**Quantity Calculation**
This quantity for this element should include the entire exposed surface of the steel element.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Chalking | None | Surface Dulling | Loss of Pigment | Loss of Pigment |
| Peeling/Curling | None | None | Minor | Exposure of Bare Metal |
| Oxide Color | Light Brown | Yellow Orange | Dark Brown | Black |
| Effectiveness | Good Condition, Fully Effective | Fair Condition, Substantially Effective | Poor Condition, Limited Effectiveness | Failed, No Protection Of The Underling Metal |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Replace |

**Element Commentary**
This element shall describe all coating systems. This includes paint systems, oxide on weathering steel and galvanization.

**Element Definitions**
Effectiveness is in evaluation made by the inspector to classify the degree to which the protection system is functioning to protect the steel beneath

| **Description**<br>This element defines all types of protective systems used to protect decks or slabs regardless of the type. | **Element # 520**<br>**Deck/Slab Protection Systems**<br>**Square Feet(Square Meters)**<br>**Bridge Management Element** |
|---|---|

**Quantity Calculation**
This quantity for this element should include the entire exposed surface of the steel element.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Effectiveness | Good condition, fully effective | Fair condition, substantially effective | Poor condition, limited effectiveness | The protective system has failed or is non-operational |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Replace |

**Element Commentary**
The deck/slab protection system element is intended to capture situations where the deck or slab may deteriorate at a rate that is slower than unprotected situations. Protection systems may include rebar coatings, cathodic protection or other similar protection methods. Wearing surfaces should be noted under the appropriate wearing surface element.

**Element Definitions**
Effectiveness is in evaluation made by the inspector to classify the degree to which the protection system is functioning.

| | |
|---|---|
| **Element # 521**<br>**Concrete Protective Coating**<br>**Square Feet(Square Meters)**<br>**Bridge Management Element** | **Description**<br>This element is for concrete elements that have a protective coating applied to them. These coating include silane/siloxane water proofers, crack sealers such as High Molecular Weight Methacrylate (HMWM) or any top coat barrier that protects concrete from deterioration and reinforcing steel from corrosion. |

**Quantity Calculation**
This quantity for this element should include the entire exposed surface of the concrete element.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Wear | None | Underlying Concrete Not Exposed. Coating Showing Wears From UV Exposure. Friction Course Missing. | Underlying Concrete Is Not Exposed. Thickness Of The Coating Is Reduced. | Underlying Concrete Exposed. Treated Cracks Are Exposed |
| Effectiveness | Good condition, fully effective | Fair condition, substantially effective | Poor condition, limited effectiveness | The protective system has failed or is non-operational |

**Feasible Actions**

| Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|
| Do Nothing | Do Nothing<br>Repair | Do Nothing<br>Repair<br>Replace | Do Nothing<br>Replace |

**Element Commentary**
None

**Element Definitions**
Effectiveness is in evaluation made by the inspector to classify the degree to which the protection system is functioning

### 3.2.5 Environmental Factors (States)

Elements exposed to different environmental conditions deteriorate differently. These factors include:

- Operational activities from traffic and truck movements
- Exposure to water, salt and other corrosive materials
- Condition of protective and water proofing systems
- Temperature extremes either from nature or man

When inventorying and assessing the condition of the elements, an inspector should consider the environment which the element is operating. The environment designation of an element can change over time; as it would if operating policies were changed to reduce the use of road salt. By definition, the environment designation cannot change as the result of maintenance work or deterioration.

| Environment | Description |
|---|---|
| 1 – Benign | Neither environmental factors nor operating practices are likely to significantly change the condition of the element over time or their effects have been mitigated by the presence of highly effective protective systems. |
| 2 – Low | Environmental factors and/or operating practices either do not adversely influence the condition of the element or their effects are substantially lessened by the application of effective protective systems. |
| 3 – Moderate | Any change in the condition of the element is likely to be quite normal as measured against those environmental factors and/or operating practices that are considered typical by the agency. |
| 4 - Severe | Environmental factors and/or operating practices contribute to the rapid decline in the condition of the element. Protective systems are not in place or are ineffective. |

Factors that could increase the severity of the environment rating for various elements include: (Record the predominant environment)

| Element | Example Environmental Factors |
|---|---|
| Timber Elements | High Moisture Content<br>Pest Infestation<br>Ice flow impacts |
| Steel Elements | Distance from salt air<br>Water wet/dry cycles<br>Exposure to corrosive soils and liquids |
| Concrete Elements | Freeze thaw cycles<br>Tire Chain wear<br>Deck salting |
| Petroleum Based | High Temperatures |
| Joints and Bearings | Extreme Temperature Ranges |
| Operating Practices | High traffic and or Truck volume |

# Appendix

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

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

## Appendix A Agency Developed Elements

The Bridge Element Inspection Manual was developed with the understanding that agencies may have the need to develop elements that are not included in the defined element set. Agency developed elements can be developed as necessary providing that they conform to these guidelines.

Agency developed elements fall into to three main categories; sub-sets of defined National Bridge Elements, Sub-sets of defined Bridge Management Elements, or elements that are independent of the defined elements.

### A.1 Agency Defined Sub-sets of the National Bridge Elements

The National Bridge Elements (NBE's) represent the primary structural components of bridges and are of national concern for safety. These elements are intended to form an element basis for the National Bridge Inventory (NBI). Because of the higher purpose for these NBE's the flexibility for an agency to customize them is limited.

An agency is permitted to create NBE sub-elements providing that the components can be aggregated back together for NBI submission. In all cases, the element condition states are fixed at four states and the specific condition state and defect criteria must remain consistent between the NBE and the agency developed NBE sub-element.

For example, many agencies have developed elements to capture the condition of their "beam ends". This agency developed element isolates the area around joints or hinges to capture the rapid deterioration that can occur in this area. Since the beam element is a NBE, this agency developed sub element would need to inherit all of the characteristics language of the NBE. The agency has simply sub divided the element quantity between two items that both share the same language. Combining the NBE beam element and the agency developed "beam ends" together is simple addition and would permit consistent reporting of this item to the NBI.

### A.2 Agency Defined Sub-sets of the Bridge Management Elements

Agency developed elements that are not a sub-set of a NBE have considerably more flexibility in customization. The Bridge Management Elements (BME's) represent many components of the bridges that require preservation but are not primary structural members. These elements include joints, wearing surfaces, protective coatings and deck protection systems. These elements as a class are defined to provide a sound basis for bridge management, but are not intended to be submitted for use in the NBI. The Bridge Element Inspection Manual has defined the basic BME's with the expectation that agencies may opt for considerable more detail in certain areas.

For example, an agency may wish to individually define the wearing surfaces typically used into their own elements to track performance and recognize cost differences for actions. In this example, these detailed wearing surface elements would be sub-elements of the general BME for wearing surfaces. For this wearing surface example, an agency would be required to define four condition states following a good, fair, poor and severe convention. The BME would not need to be "rolled" up for national purposes and therefore would not have to have the same condition state language or defect listings.

When developing a sub-element of one of the defined 500 series BME's, the agency needs to consider the potential impacts on the deterioration modeling in their BMS. The BME's for protective coatings, wearing surfaces and protection systems may need to be set-up to influence the deterioration rates of certain elements. The relationship between these "protective" BME's and other elements (NBE's or BME's) must be considered if the agency wishes to have the deterioration modeling influenced by the protective element. For example, the steel protective coating element (BME # 515) defines condition state language that covers conventional paint systems, weathering steel and galvanized protective coatings. An agency may wish to break these three classes of protective coatings into their own BME to capture performance or cost differences between them. All of these protective coatings will influence the rate of deterioration of the base element that they are designed to protect. Bridge Management Systems (BMS) such as the AASHTOWare Pontis program will slow or eliminate deterioration of the base element as long as the protective element is in good condition. This relationship between protective system and base element will

constrain the degree of customization that an agency can exercise on the condition state element definitions of sub-elements to the 500 series of BME's.

### A.3 Independent Agency Developed Elements

Agencies who wish to develop element that are not a sub-set of an NBE or BME may do so as necessary for their business. Elements that are not sub-set of any defined element provide the most flexibility as these elements are not intended to be reported at a national level nor are they expected to be rolled up into any element with defined condition state language in this manual. These elements are available for agencies utilizing bridge management systems to track specific aspects of their inventory or to capture specific performance aspects of bridges. Independent agency developed elements may or may not have defined feasible actions, defined deterioration and need not follow any condition state or defect language included in this manual. These are free form element items that are only limited by the number of required condition states (four).

Examples of independent agency developed elements could include; approach guardrail, slope paving, seismic retrofit components, or tunnels just to name a few. These elements may or may not have defined deterioration patterns or feasible actions.

Independent agency elements could also be created to track maintenance items that an agency wishes to capture during the inspection process. Items such as the condition of drains, structure lighting, or bridge identification plaques could be developed into elements that are not associated with deterioration but potentially have feasible actions.

Independent agency developed elements can also be created to a capture ancillary structure items that an agencies may wish to inspect. These elements can coexist side by side with the bridge elements and can optionally be defined with deterioration models or feasible actions as an agency desires. This provides a readymade framework for capturing items such as tunnels, wall and overhead sign structures within the agencies BMS.

**Tunnel - Ancillary Structure Example**

| | |
|---|---|
| **Element #600**<br>**Concrete Tunnel**<br>**Feet (Meters)**<br>**Agency Developed Element Example** | **Description**<br>This element defines all concrete tunnels. |

**Quantity Calculation**
The quantity for this element is the sum of the lengths of the bores.

**Condition State Definitions**

| Defect | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| Spalls/ Delaminations/ Patch Areas | None | May be present | May be present | The retaining capacity of the tunnel been reduced due to the condition |
| Exposed Rebar | None | None | Corrosion without section loss | |
| Cracks | Hairline Cracks Only | Narrow size or density | Moderate size and density | |
| Efflorescence | None | Moderate but without rust | May be severe with rust staining | |
| Distortion | None | None | Tolerable without reducing load capacity | |
| Load Capacity | No Reduction | No Reduction | No Reduction | |

**Feasible Actions**

| | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|
| | Do Nothing<br>Protect | Do Nothing<br>Protect | Do Nothing<br>Protect<br>Repair<br>Rehab | Do Nothing<br>Rehab<br>Replace |

**Element Commentary**
None

**Element Definitions**

| Defect | Shrinkage | Moderate | Severe |
|---|---|---|---|
| Cracking | < 0.005 inches (0.1 mm) | 0.02– 0.08 inches (0.5 – 2.0 mm) | >0.08 inches (2.0 mm) |
| Cracking Density | N/A | 1.0 - 3.0 feet apart (0.33 – 1.0 m) | < 1 foot (0.33 m) |
| Efflorescence | N/A | Surface white without build-up or leaching | Heavy build-up with rust staining |

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# Appendix B Inspection Examples

The examples provided are to show the minimal inspection with the National Bridge Elements (NBE) and an in-depth example using the combination of National Bridge Elements and the Bridge Management Elements (BME). The examples will cover concrete, steel and timber.

## B.1 Timber Bridge

A two span timber bridge has an out-to-out width of 40 feet (12 meters) and each span is 30 feet (9 meters). The bridge rail is constructed of timbers. The timber deck has a 2 inches (50 millimeters) asphalt cover. The superstructure consists of thirteen girder lines on timber caps and five timber pile bents. The structure has no joints. The length of each wingwall is 10 feet (3 meters).

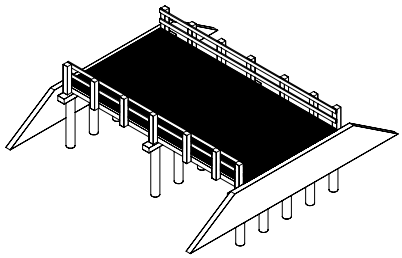
An inspection of the structure shows that the bridge elements are in good condition and has no noticeable defects accept for the deck and pile caps.

*Deck Elements and Quantities*
This timber structure was constructed with a deck/girder system. The timber deck is covered by asphalt. The total quantity for this element is (2 span X 30 feet (9 meters) per span X 40 feet (12 meters) wide) or 2,400 Sq Ft (216 Sq M).
The rail element on this structure is the timber bridge rail. The quantity for this element is (2 spans X 30 feet (9 meters) X 2 sides) or 120 feet (36 meters).

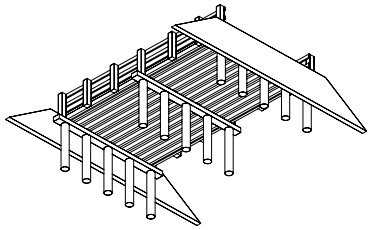
*Superstructure Elements and Quantities*
The primary superstructure element is the open timber girders. The quantity for this element is (2 spans X 30 feet (9 meters) X 13 girders) or 780 feet (234 meters).
Substructure Elements and Quantities
The remaining elements are all substructure elements. The first element is the timber abutment. This element for timber only covers the back wall and the wingwalls. The quantity for this item is [(2 wingwalls X 10 feet (3 meter) per wingwall+ 40 feet (12 meter) under the roadway) X 2 abutments] or 120 feet (36 meter).

The girders are resting on pile caps. There are 3 pile caps (one at each abutment and one at the center bent). This element is the timber pile caps. The quantity for this element is (40 feet (12 meter) per cap X 3 caps) or 120 feet (36 meter).

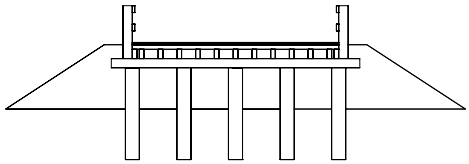
*Substructure Elements and Quantities*
The last items are the piles. These piles were constructed of timber and the inspectable area is above ground level. This element is the timber pile extension. The quantity for this element is (5 per pile cap X 3 pile caps) or 15 each.



Top view – revealing top condition and elements.



Bottom view – revealing underside elements and substructure elements



Cross section – displaying typical section of the bridge with all of the elements.

National Bridge Element List

| Element Number | Element Description | Unit of Measure | Total Quantity | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|---|---|---|
| 31 | Timber Deck | Sq Ft (sq m) | 2,400 | 100% | 0% | 0% | 0% |
| 111 | Timber Girder/Beam | Feet (meter) | 780 | 100% | 0% | 0% | 0% |
| 206 | Timber Column/Pile Extension | Each | 15 | 100% | 0% | 0% | 0% |
| 216 | Timber Abutment | Feet (meter) | 120 | 100% | 0% | 0% | 0% |
| 235 | Timber Pier Cap | Feet (meter) | 120 | 100% | 0% | 0% | 0% |
| 332 | Timber Bridge Railing | Feet (meter) | 120 | 100% | 0% | 0% | 0% |

The above list is the minimal list needed to evaluate the structure for condition. Agencies needed additional information should collect these additional elements to support a bridge management system.

Bridge Management Element List (including the MBE elements)

| Element Number | Element Description | Unit of Measure | Total Quantity | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|---|---|---|
| 31 | Timber Deck | Sq Ft (sq m) | 2,400 | 100% | 0% | 0% | 0% |
| 111 | Timber Girder/Beam | Feet (meter) | 780 | 100% | 0% | 0% | 0% |
| 206 | Timber Column/Pile Extension | Each | 15 | 100% | 0% | 0% | 0% |
| 216 | Timber Abutment | Feet (meter) | 120 | 100% | 0% | 0% | 0% |
| 235 | Timber Pier Cap | Feet (meter) | 120 | 100% | 0% | 0% | 0% |
| 332 | Timber Bridge Railing | Feet (meter) | 120 | 100% | 0% | 0% | 0% |
| ***510*** | ***Wearing Surfaces*** | ***Sq Ft (sq m)*** | ***2,400*** | ***100%*** | ***0%*** | ***0%*** | ***0%*** |

NBE elements
***BME elements***

## B.2 Two Span Concrete AASTHTO Girder Structure

A concrete structure has span lengths of 100 ft (30 m). The skew angle is zero. The out-to-out width of the structure is 46 ft (14 m). The center bent is placed in a slow-moving stream. The beams are Type A. The abutments are constructed of concrete. Each abutment has an open joint and the center span has a Jeene preformed seal joint. The bearings at each abutment are elastomeric that are 1 3/4" tall and are not slotted at the connection plate. At the center bent the bearing is an elastomeric pad that is 1 ½" thick and is slotted at the connection plate. The wingwall width is 33 ft (10 m) on each side. The piles, constructed of reinforced concrete, are cast-in-place. The columns and cap were constructed monolithically with reinforced concrete.

The inspector made a detailed inspection of the bridge. The inspector observed that the abutments showed no signs of spalls or efflorescence. Ten percent (10%) of the deck had exposed non-corroding reinforcement. In addition, the underside of the deck showed some efflorescence (3%). The bridge rail had some minor traffic impacts but material loss was not noticeable. The girders, columns, joints and bearings have no apparent defects.

*Deck Elements and Quantities:*
The surface of the deck is the original surface. The structure was not constructed on a skew. The area of deck is (2 spans X 100 ft (30 m) long X 46 ft (14 m) wide) or 9200 sq ft 840 sq M.
From the typical section, the structure has two concrete barriers. The quantity for this element is the length of railing (100 ft (30 m) per span X 2 spans X 2 sides) or 400 ft (120 m).

The last deck items are the joints. Two different joint types are present on this bridge. The end joints are open joints. Since we do not have a skewed joint, the skew angle is zero. The out-to-out width of the deck is 46 ft (14 m). The total quantity calculation for this element is [(46 ft (14 m) X 2 joints)/cos(0)] or 92 ft (28 m). The other joint on this structure is a Jeene preformed sealed joint. The calculation for the joint is the same as the open joint previously calculated. The total quantity is [(46 ft (14 m) X 1 joints)/cos(0)] or 46 ft (14 m).

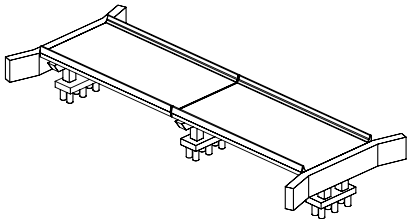
*Superstructure Elements and Quantities*
The deck is supported by three rows of AASHTO Type A girders. The quantity of this girder element is (3 rows X 2 spans X 100 ft (30 m) per span) or 600 ft (180 m).

The other superstructure element is the bearings. This structure has two different systems bearings. Center bent has movable elastomeric and the end bearings are fixed. The quantity of fixed bearings for this structure is (1 per beam X 2 connection points) or a total of 6. The total number of movable bearings for this structure is 6.

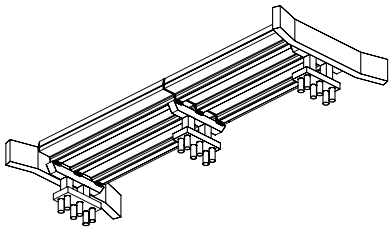
*Substructure Elements and Quantities*
The substructure consists of abutments and a center bent. The length of the abutment includes the pier cap, back wall and wingwalls. The width of the structure is 46 ft (14 m) and each wing of the wing wall is 33 ft (10 m). The total quantity is [(2 total wingwalls per abutment X 33 ft (10 m) for each wing wall + 46 ft (14 m) back wall) X 2 abutments] or 224 ft (68 m).

The columns are cast-in-place columns. This bent has 2 columns.

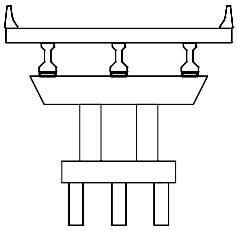
The last item is the pier cap. Since the cap was poured monolithically with the columns, it is probably reinforced concrete. The total quantity is [(1 pier cap X 46 ft (14 m) width)/cos(0)] or 46 ft (14 m).
Since the pile and the cap are not exposed, they were not considered in the list of elements.



Top view – revealing top condition and elements.



Bottom view – revealing underside elements and substructure elements



Cross section – displaying typical section of the bridge with all of the elements.

National Bridge Element List

| Element Number | Element Description | Unit of Measure | Total Quantity | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|---|---|---|
| 12 | Concrete Deck | Sq Ft (sq m) | 9,200 | 87% | 3% | 10% | 0% |
| 109 | Prestress Girder/Beam | Feet (Meters) | 600 | 100% | 0% | 0% | 0% |
| 205 | Reinforced Concrete Column/Pile Extension | Each | 2 | 100% | 0% | 0% | 0% |
| 310 | Elastomeric Bearing | Each | 6 | 100% | 0% | 0% | 0% |
| 331 | Reinforced Concrete Bridge Railing | Feet (Meters) | 120 | 100% | 0% | 0% | 0% |
| 215 | Reinforced Concrete Abutment | Feet (Meters) | 224 | 100% | 0% | 0% | 0% |
| 234 | Reinforced Concrete Pier Cap | Feet (Meters) | 46 | 100% | 0% | 0% | 0% |
| 310 | Elastomeric Bearing | Each | 6 | 100% | 0% | 0% | 0% |
| 331 | Reinforced Concrete Bridge Railing | Feet (Meters) | 120 | 100% | 0% | 0% | 0% |

The above list is the minimal list needed to evaluate the structure for condition. Agencies needed additional information should collect these additional elements to support a bridge management system.

Bridge Management Element List (including the BME elements)

| Element Number | Element Description | Unit of Measure | Total Quantity | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|---|---|---|
| 12 | Concrete Deck | Sq Ft (sq m) | 9,200 | 87% | 3% | 10% | 0% |
| 109 | Prestress Girder/Beam | Feet (Meters) | 600 | 100% | 0% | 0% | 0% |
| 205 | Reinforced Concrete Column/Pile Extension | Each | 2 | 100% | 0% | 0% | 0% |
| 215 | Reinforced Concrete Abutment | Feet (Meters) | 224 | 100% | 0% | 0% | 0% |
| 234 | Reinforced Concrete Pier Cap | Feet (Meters) | 46 | 100% | 0% | 0% | 0% |
| 310 | Elastomeric Bearing | Each | 6 | 100% | 0% | 0% | 0% |
| 331 | Reinforced Concrete Bridge Railing | Feet (Meters) | 120 | 100% | 0% | 0% | 0% |
| ***302*** | ***Compression Joint Seal*** | ***Feet (Meters)*** | ***46*** | ***100%*** | ***0%*** | ***0%*** | ***0%*** |
| ***304*** | ***Open Expansion Joint*** | ***Feet (Meters)*** | ***92*** | ***100%*** | ***0%*** | ***0%*** | ***0%*** |

NBE elements
***BME elements***

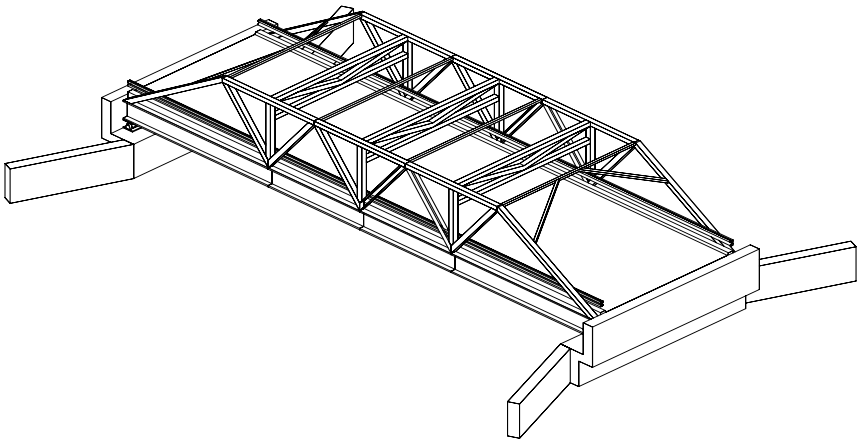
### B.3 Painted Steel Truss

A steel truss bridge has a span of 264 ft (80 m). The deck width is 40 ft (12.3 m). It has painted steel members and was constructed on a reinforced concrete abutment with wingwalls of 30 ft (9 m). The deck material is reinforced concrete. In the transverse direction, there are three panels of sway bracing. The bridge rail is galvanized steel W beam. The floor beams are spaced at 66 ft (20 m). All of the steel truss members have scaling paint with freckled rust. The bottom chord, floor beam and stringers have curling paint. Three of the stringers have section loss [3 beams 2 end 1 ft (0.3 m) or 6 ft (1.8 m)] due to corrosion at the ends. The corroded members were repaired by cleaning and repainting. Rerating of the stringers indicated that the section loss did not reduce the structural capacity. At the fixed end of the structure, there is an open joint. Over the movable bearing, there is an assembly joint without a seal. In addition, one movable bearing has a buildup of debris that is restricting the movement of the bearing. The other movable bearing is free to move. The paint on all of the bearings is good.

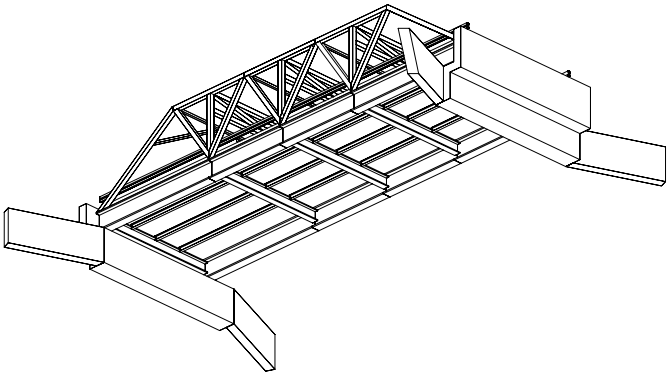
*Deck Elements and Quantities*
The structure has a concrete deck with no protection system. This element is NBE 12, Concrete Deck. The quantity for this element is [40 ft (12.3 m) X 264 ft 80 m] or 10,560 sqft (984 sqm). The structure has one open joint. This element is BME 304, Open Joint. The quantity for this element is [(1 joints X 40 ft (12.3 m) wide)/cos (0°)] or 40 ft (12.3 m). The structure has one assembly joint. This element is BME 305, Assembly Joint without Seal. The quantity for this element is [(1 joints X 40 ft (12.3 m) wide)/cos (0°)] or 40 ft (12.3 m). Bridge rail on the truss is galvanized steel W section. The quantity for the bridge rail is 264 ft (80 m) x 2 rails or 528 ft (160 m). The coating on the rail is 1,100 sqft (102 sqm).

*Superstructure Elements and Quantities*
The structure has several superstructure elements. The first are the truss elements. All of the truss elements are together. This element is NBE 126, Steel Truss. The quantity for this element is (2 X 264 ft (80 m) of span) or 528 ft 160 m. The steel truss panel is constructed with back-to-back C6x8.2 with cover plates on top and bottom and a bottom cord is a W18x35. The paint for the truss panel is 7,680 sqft (714 sqm) .This trusses have a system of stringers and floor beams. The floor beam element is NBE 152, Steel Floor Beam. The quantity is (5 floor beams X 40 ft 12.3 out-to-out width) or 200 ft (61.5 m). The floor beams are W16X26 which will require 1,000 sqft (93 sqm) of paint. The last beam element of the floor system is the stringers (interior longitudinal elements). This element is NBE 113, Steel Stringers. The quantity for this element is (3 stringer rows X 264 ft (80 m) span) or 792 ft (240 m). The stringers are W10x12. The paint area is 2,376 sqft (221 sqm). There are two different bearings on this bridge. The first are the rocker bearings at the expansion end. This element is BME 311, Moveable Bearings. The quantity for this element is 2 each. At the other end of the structure there are fixed bearings. This element is 313, Fixed Bearings. The quantity for this element is 2 each. Each bearing will require 100 sqft (9 sqm) of paint.

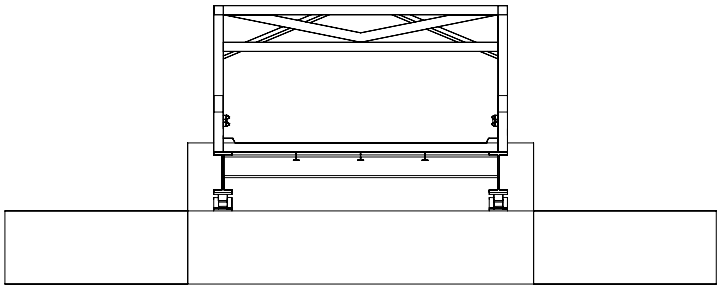
*Substructure Elements and Quantities*
The only substructure element on this structure is the abutment. The abutment is element 215, Reinforced Concrete Abutment. The quantity for this element is [(2 wingwalls X 30 ft (9 m) + 40 ft (12.3 m) width) X 2 abutments] or 200 ft (60.6 m).



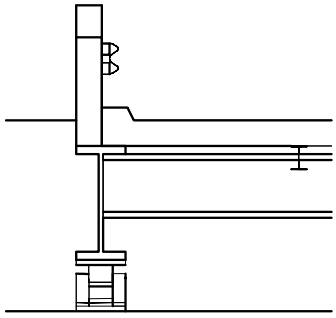
Top view – revealing top condition and elements.



Bottom view – revealing underside elements and substructure elements

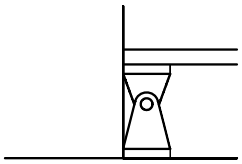


Cross section – displaying typical section of the bridge with all of the elements.



Typical Bearing Configuration

Typical Fixed Bearing



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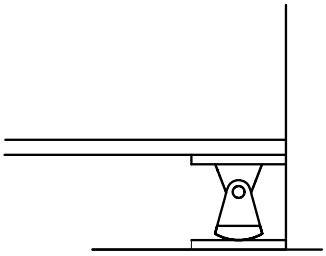
Typical Movable Bearing



National Bridge Element List

| Element Number | Element Description | Unit of Measure | Total Quantity | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|---|---|---|
| 12 | Concrete Deck | Sq Ft (sq m) | 9,200 | 100% | 0% | 0% | 0% |
| 113 | Steel Stringers | Feet (Meters) | 792 | 0% | 99% | 1% | 0% |
| 126 | Steel Truss | Feet (Meters) | 528 | 0% | 100% | 0% | 0% |
| 152 | Steel Floor Beams | Feet (Meters) | 200 | 0% | 100% | 0% | 0% |
| 215 | Reinforced Concrete Abutment | Feet (Meters) | 200 | 100% | 0% | 0% | 0% |
| 311 | Moveable Bearings | EA | 2 | 50% | 0% | 50% | 0% |
| 313 | Fixed Bearings | EA | 2 | 100% | 0% | 0% | 0% |
| 330 | Metal Bridge Rail | Feet (Meters) | 528 | 100% | 0% | 0% | 0% |

The above list is the minimal list needed to evaluate the structure for condition. Agencies needed additional information should collect these additional elements to support a bridge management system.

Bridge Management Element List (including the MBE elements)

| Element Number | Element Description | Unit of Measure | Total Quantity | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|---|---|---|
| 12 | Concrete Deck | Sq Ft (sq m) | 9,200 | 100% | 0% | 0% | 0% |
| 113 | Steel Stringers | Feet (Meters) | 792 | 0% | 99% | 1% | 0% |
| ***363 (113)*** | ***Steel Section Loss*** | ***Feet (Meters)*** | ***6*** | ***0%*** | ***0%*** | ***1%*** | ***0%*** |

| Element Number | Element Description | Unit of Measure | Total Quantity | Condition State 1 | Condition State 2 | Condition State 3 | Condition State 4 |
|---|---|---|---|---|---|---|---|
| ***515 (113)*** | ***Steel Protective Coating*** | ***Sqft (Sqm)*** | ***2,376*** | ***0%*** | ***0%*** | ***100%*** | ***0%*** |
| 126 | Steel Truss | Feet (Meters) | 528 | 0% | 100% | 0% | 0% |
| ***515 (126)*** | ***Steel Protective Coating*** | ***Sqft (Sqm)*** | ***7,680*** | ***0%*** | ***0%*** | ***100%*** | ***0%*** |
| 152 | Steel Floor Beams | Feet (Meters) | 200 | 0% | 100% | 0% | 0% |
| ***515 (152)*** | ***Steel Protective Coating*** | ***Sqft (Sqm)*** | ***1,000*** | ***0%*** | ***0%*** | ***100%*** | ***0%*** |
| 215 | Reinforced Concrete Abutment | Feet (Meters) | 200 | 100% | 0% | 0% | 0% |
| 311 | Moveable Bearings | EA | 2 | 50% | 0% | 50% | 0% |
| ***515 (311)*** | ***Steel Protective Coating*** | ***Sqft (Sqm)*** | ***20*** | ***100%*** | ***0%*** | ***0%*** | ***0%*** |
| 313 | Fixed Bearings | EA | 2 | 100% | 0% | 0% | 0% |
| ***515 (313)*** | ***Steel Protective Coating*** | ***Sqft (Sqm)*** | ***20*** | ***100%*** | ***0%*** | ***0%*** | ***0%*** |
| 330 | Metal Bridge Rail | Feet (Meters) | 528 | 100% | 0% | 0% | 0% |
| ***515 (330)*** | ***Steel Protective Coating*** | ***Sqft (Sqm)*** | ***1100*** | ***100%*** | ***0%*** | ***0%*** | ***0%*** |
| ***304*** | ***Open Joint*** | ***Feet (Meters)*** | ***40*** | ***100%*** | ***0%*** | ***0%*** | ***0%*** |
| ***305*** | ***Assembly Joint without Seal*** | ***Feet (Meters)*** | ***40*** | ***100%*** | ***0%*** | ***0%*** | ***0%*** |

NBE elements
***BME elements***

Elements 363 and 515 are associated with the parent structural element.

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## Appendix C Element Grouping

This section graphically displays the NBE, BME and obsolete elements. The charts show the elements by type, deck, superstructure, substructure and smart flags.

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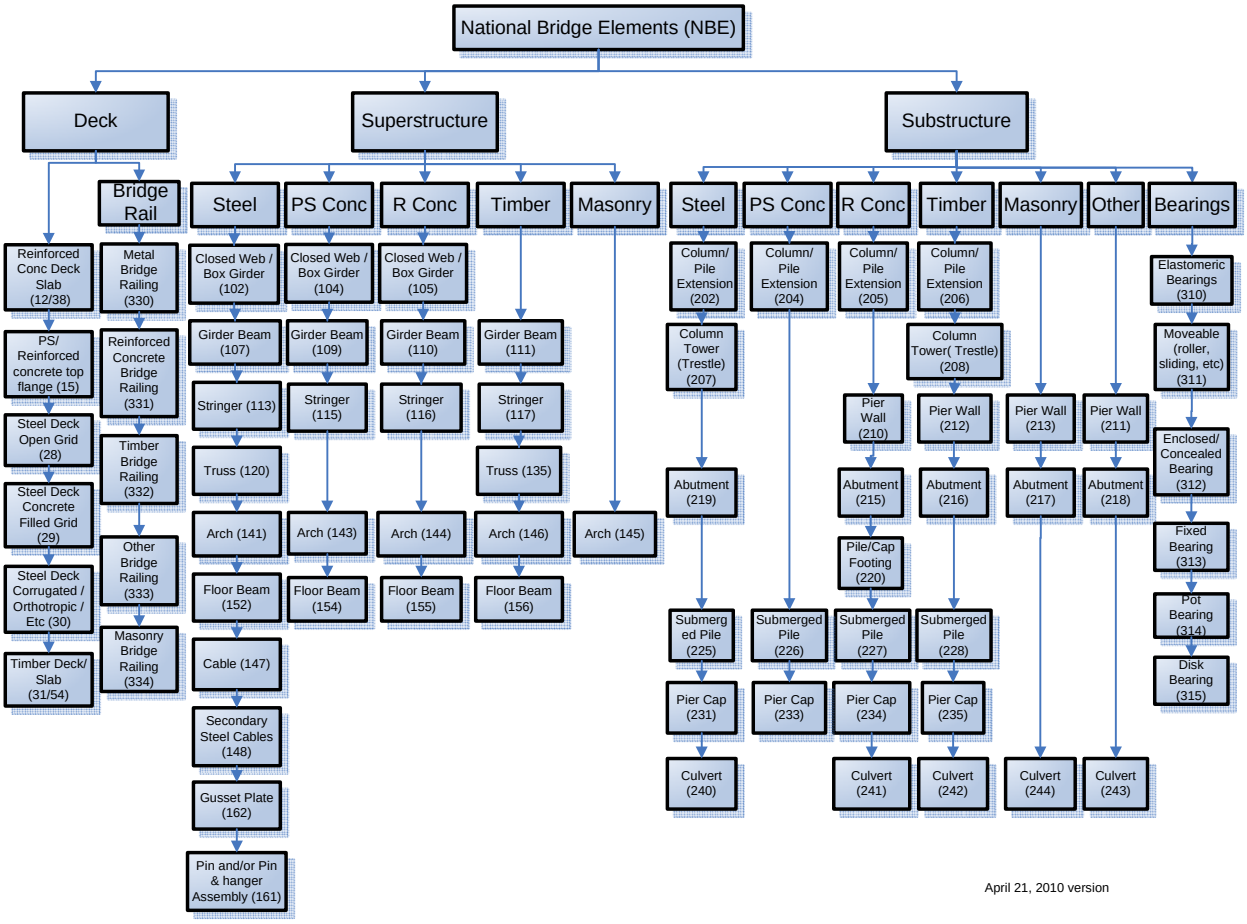
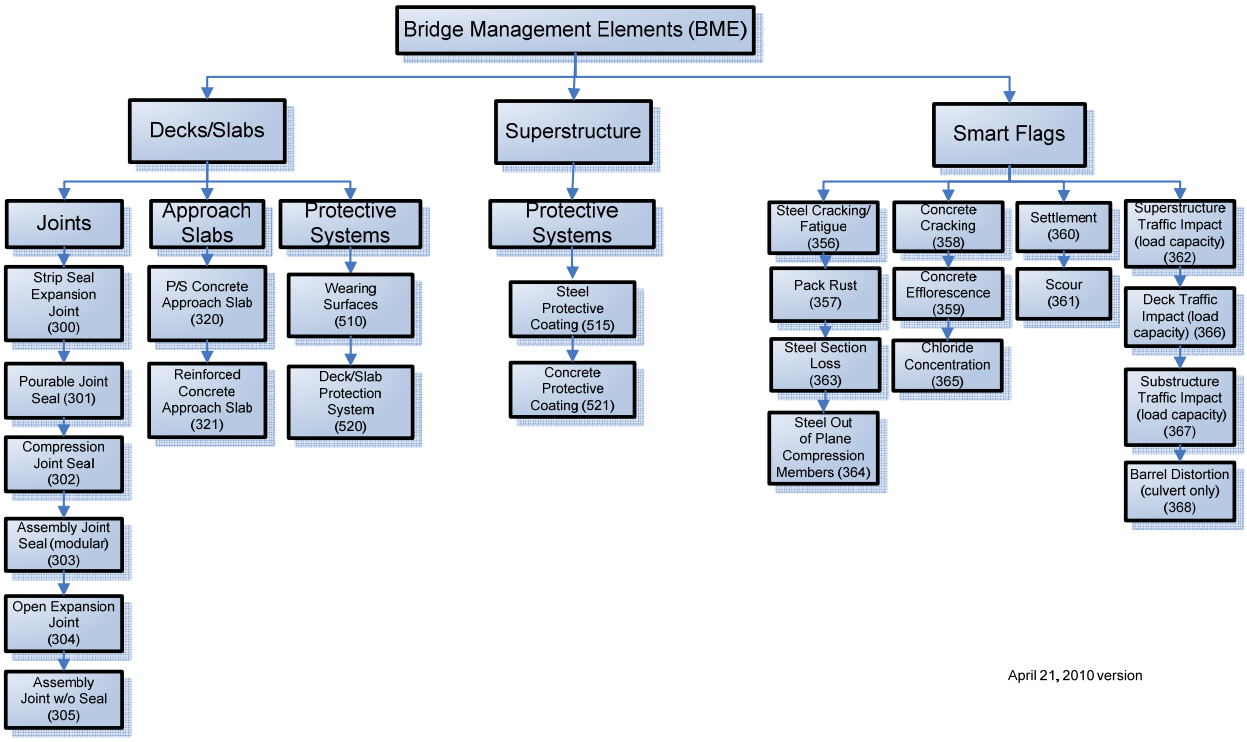
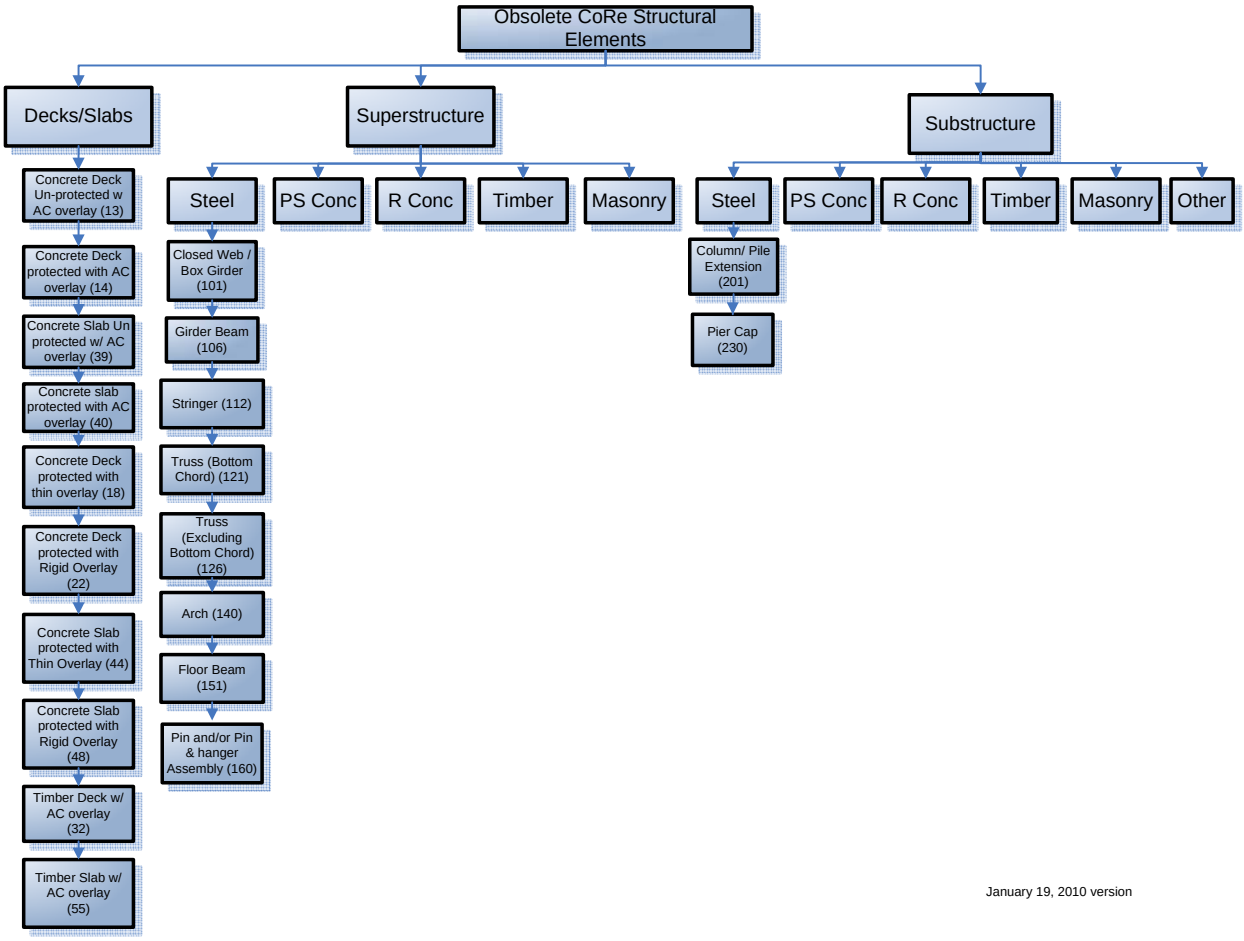
## C.1 National Bridge Elements (NBE)



## C.2 Bridge Management Elements (BME)



## C.3 Obsolete Elements from CoRe Guide



# Appendix D Migration from CoRe Elements

This appendix is to give guidance on developing a migration schema for migration of data from the AASHTO Guide for Commonly Recognized (CoRe) Structural Elements 2002 to this guide. Many of the items are fundamentally the same; there have been changes in the element language. In addition to the language, the division of structural elements, protective systems and the smart flags will require restructuring the existing element/smart flag combinations. The migration process will be divided into grouping of deck, superstructure and substructure. The flow diagrams will cover a simple conversion from CoRe to National Bridge Elements (NBE) only and will cover the combination of CoRe with Smart Flags to National Bridge Elements and Bridge Management Elements (BME) (these BME elements include Smart Flags). The elements from the previous manual had condition state language that varied from three state to five states. This manual states that all of the elements contain only four condition states.

Each section will be divided into deck, superstructure and substructure section with a division into element materials. Each section will have a migration flow diagram and an example.
This section is not comprehensive and agencies will need to develop a process to migrate agency elements to the new format.

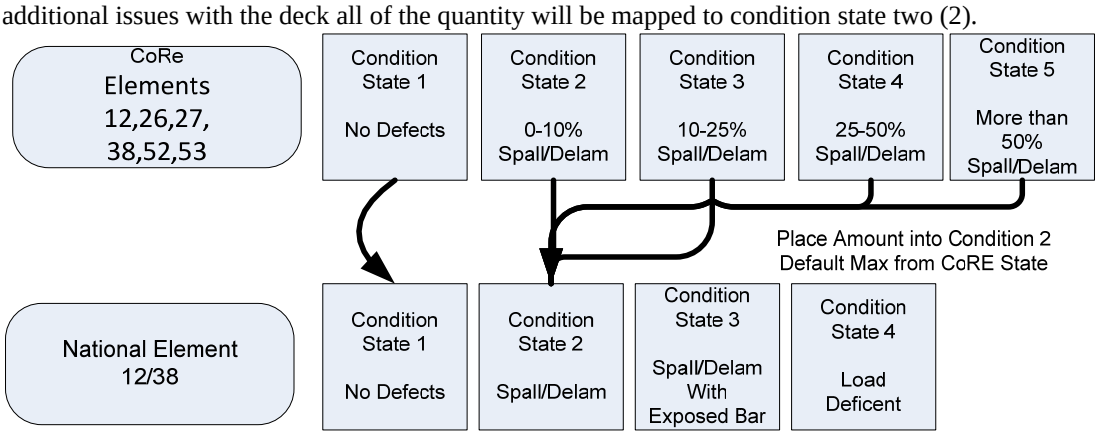
## D.1 Deck Elements

From the existing CoRe guide, the deck elements moved unitarily. That is, its quantity is all in one state. The element language only addressed the spalls and delaminations and the condition was dependent on the percent of the deck with this defect. These elements had five or four condition states.

### D.1.1 Concrete

*Example Deck 1 – Deck Elements Only*

Since the existing element language only discusses spalls and delaminations and divides the quantity into conditions states, the mapping of the conditions are illustrated below. Since there was no discussion or smart flag indicating additional issues with the deck all of the quantity will be mapped to condition state two (2).




Existing Deck/Slab Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 | CS 5 |
|---|---|---|---|---|---|
| 12,26,27,38,52,53 | 0 | 0 | 0 | 0 | 100 |

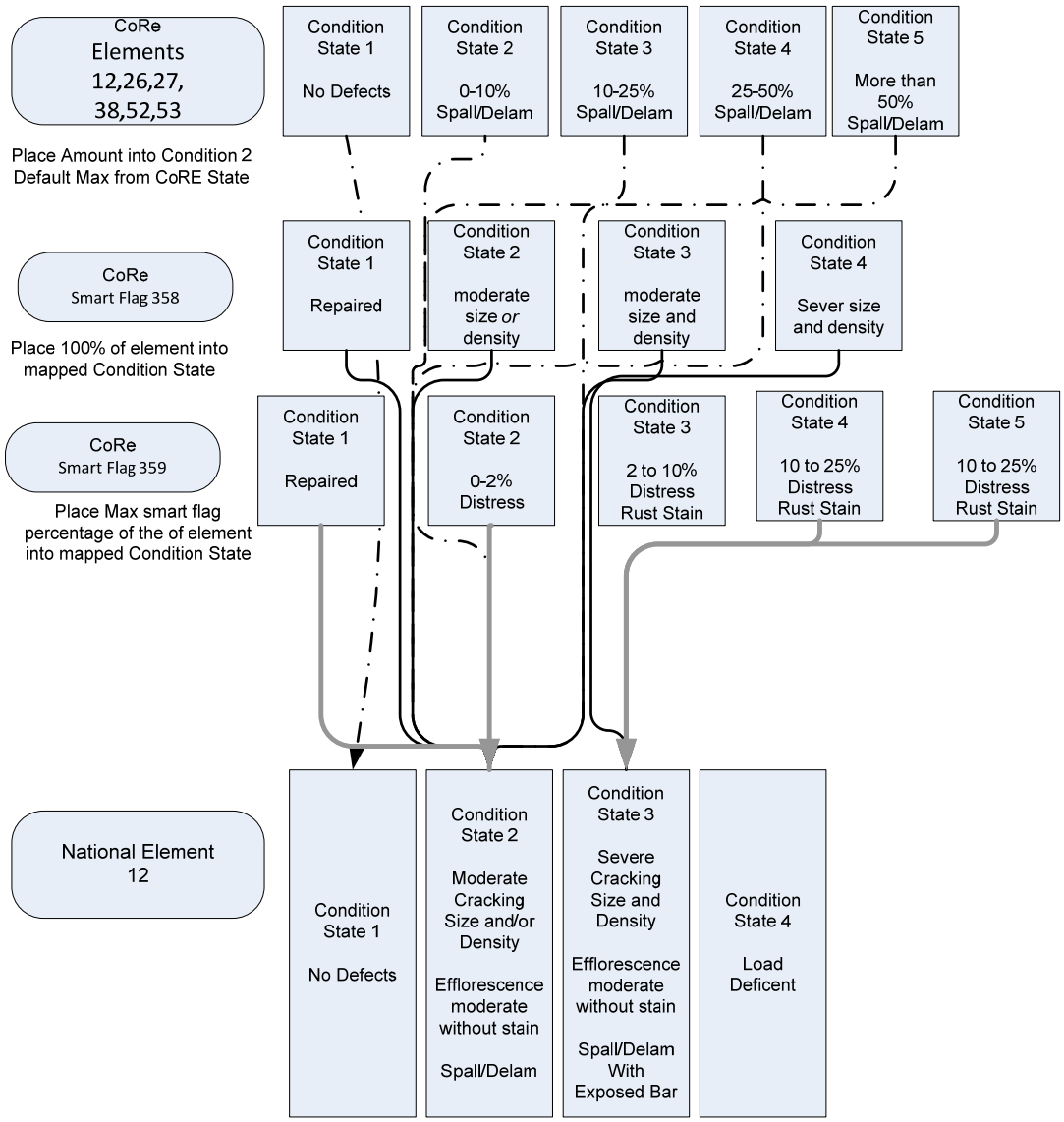
New NBE Element

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 12,38 | 0 | 100 | 0 | 0 |

*Example Deck 2 - Deck Element and Smart Flags*

Example two will show the conversion with smart flags to the appropriate NBE. The conversion will apply the flags and the quantification of the spalling/delaminations to the appropriate condition state. When evaluating the element, the user must consider the deck as a three dimensional unit. The evaluation is for the top and the bottom of the deck. The conversion should consider the worst condition first and fill the other conditions as conditions dictate.

The conversion process will be resolved from the work flow shown. Since the existing CoRe language for concrete decks does not discuss issues of exposed reinforcing steel, none of the deck element is condition state three (3). Since there is no discussion on the quantity other than fifty one (51) to one hundred (100) percent in condition state five (5), all of the quantity for spall and delaminations are in condition state two (2). Considering the deck condition from the smart flags, the only one that has quantities with condition is the soffit flag. From this example the soffit flag has a distress area between ten (10) and twenty-five (25) percent. Not knowing the exact amount assume the worst, twenty-five (25) percent. The cracking smart flag is for all of the deck and the cracks are of moderate size and density. We need to place one hundred (100) percent in condition one (1). Looking at the worst to best ranking and extracting the percentages accordingly, the worst is from the soffit and the best is from the cracking and the spall and delaminations.



Existing Deck/Slab Elements

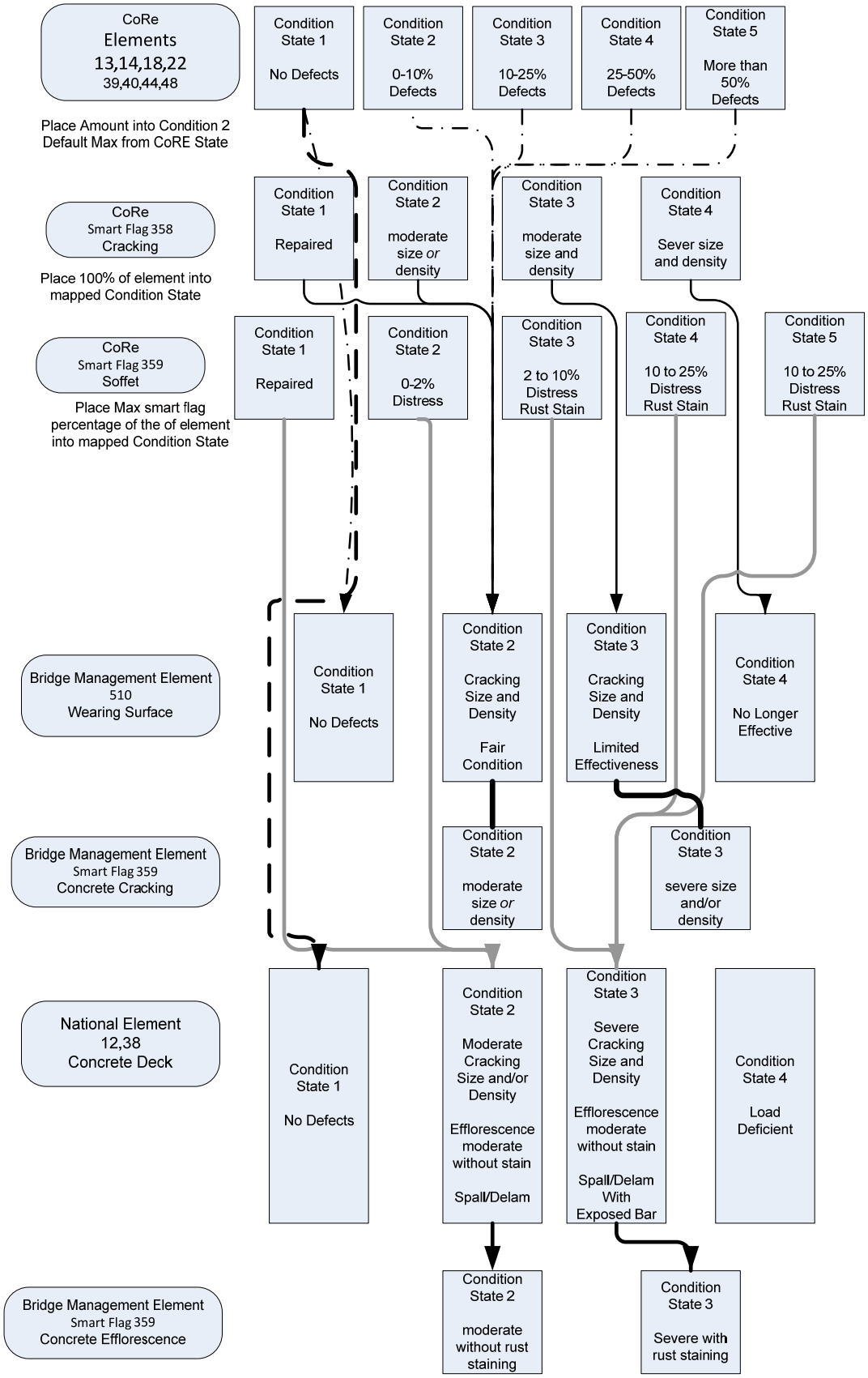
| Element Number | CS 1 | CS 2 | CS 3 | CS 4 | CS 5 |
|---|---|---|---|---|---|
| 12,26,27,38,52,53 | 0 | 0 | 0 | 0 | 100 |
| 358 (cracking) | 0 | 0 | 1 ea | 0 | X |
| 359 (soffit) | 0 | 0 | 0 | 1 ea | 0 |

New NBE Element

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 12,38 | 0 | 75 | 25 | 0 |

*Example Deck 3 - Deck Element and Smart Flags with Bridge Management Elements*

This example will include all of the possibilities of collecting data from a concrete deck. This includes wearing surface and smart flags. The example will show how to derive the NBE the BME items and approximate the quantities. The deck is an asphaltic overlay with cracking and soffit smart flags. The cracking smart flag is for the concrete deck section that is exposed from the missing asphalt wearing surface.
From the element information, the bridge has an asphalt cover that is in condition state three (3), a cracking smart flag in condition state three (3) and a soffit smart flag in condition state four (4). The cracking smart flag is for the concrete of the deck not the asphalt cover material. The reduction from worst to best is as follows. The deck element is divided into two elements, concrete deck 12 and riding surface 510. The smart flags are for the deck consideration and the deck spalling/delaminations are unknown. The breakdown of condition for the deck is twenty-five (25) percent condition state three (3) and twenty five percent in condition state two (two) since that is the only section that is exposed and has a cracking smart flag associated with it. The remaining deck is in condition state one (1) since we do not have any additional information that support placing the condition somewhere between condition two (2) and four (4). The soffit from the previous inspection is in condition state three (3) which will give use 25 percent in condition three (3). The BME smart flags will be place in condition that represents the condition language of the deck element. In this case the cracking smart flag will be in condition two (2) and the soffit smart flag in condition three (3). All of the BME elements will be associated with the structural element, deck.


CoRe
Elements
13,14,18,22
39,40,44,48
Place Amount into Condition 2
Default Max from CoRE State
Condition State 1
No Defects
Condition State 2
0-10% Defects
Condition State 3
10-25% Defects
Condition State 4
25-50% Defects
Condition State 5
More than 50% Defects
CoRe
Smart Flag 358
Cracking
Place 100% of element into mapped Condition State
Condition State 1
Repaired
Condition State 2
moderate size or density
Condition State 3
moderate size and density
Condition State 4
Sever size and density
CoRe
Smart Flag 359
Soffet
Place Max smart flag percentage of the of element into mapped Condition State
Condition State 1
Repaired
Condition State 2
0-2% Distress
Condition State 3
2 to 10% Distress Rust Stain
Condition State 4
10 to 25% Distress Rust Stain
Condition State 5
10 to 25% Distress Rust Stain
Bridge Management Element
510
Wearing Surface
Condition State 1
No Defects
Condition State 2
Cracking Size and Density
Fair Condition
Condition State 3
Cracking Size and Density
Limited Effectiveness
Condition State 4
No Longer Effective
Bridge Management Element
Smart Flag 359
Concrete Cracking
Condition State 2
moderate size or density
Condition State 3
severe size and/or density
National Element
12,38
Concrete Deck
Condition State 1
No Defects
Condition State 2
Moderate Cracking Size and/or Density
Efflorescence moderate without stain
Spall/Delam
Condition State 3
Severe Cracking Size and Density
Efflorescence moderate without stain
Spall/Delam With Exposed Bar
Condition State 4
Load Deficient
Bridge Management Element
Smart Flag 359
Concrete Efflorescence
Condition State 2
moderate without rust staining
Condition State 3
Severe with rust staining

Existing Deck/Slab Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 | CS 5 |
|---|---|---|---|---|---|
| 13,14,18,2239,40,44,48 | 0 | 0 | 100 | 0 | 0 |
| 358 (cracking) | 0 | 0 | 1 ea | 0 | X |
| 359 (soffit) | 0 | 0 | 0 | 1 ea | 0 |

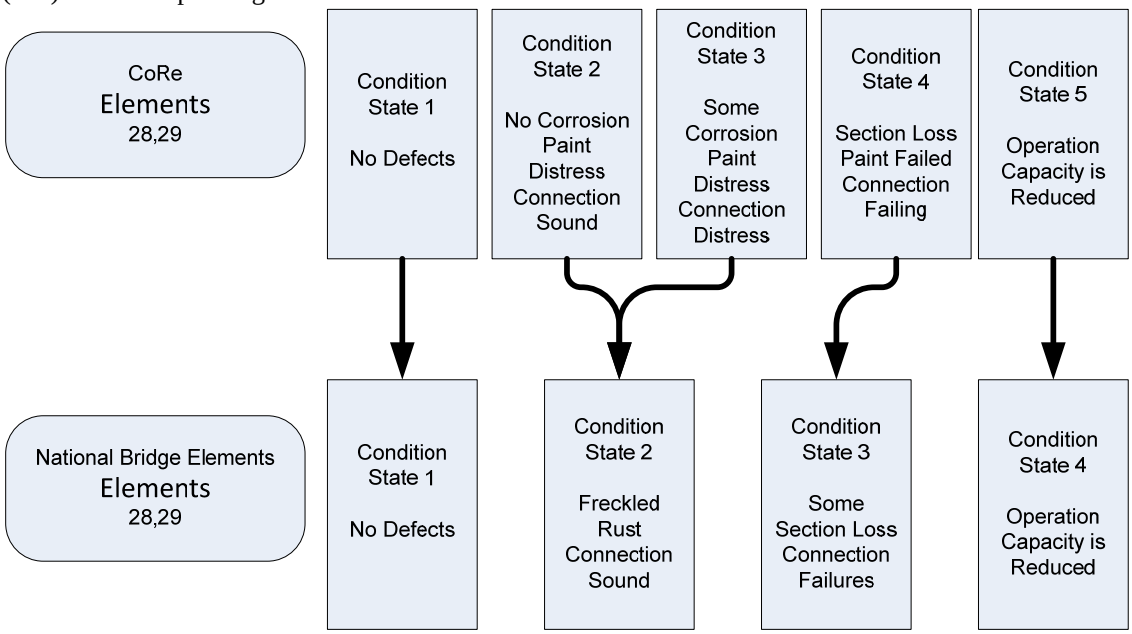
New NBE and BME Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 12,38 (NBE) | 25 | 50 | 25 | 0 |
| 358 Cracking (BME) Associated with Element 12,38 | | X | | |
| 359 Soffit (BME) Associated with Element 12,38 | | | X | |
| 510 Wearing (BME) | 50 | 50 | 0 | 0 |

### D.1.2 Steel

*Example Deck 4 – Grid Deck Elements Only*

This example will cover the steel grid elements. The mapping of condition states one (1) and five (5) correspond to condition of the elements new and failure states. Since the new language removes the coating system from the structural evaluation. With this removal, condition states two (2) and three (3) from the CoRe language are identical. These states will map to condition state two (2). The remaining condition state four (4) will map to three (3). Since there is no way to find the distribution of the condition states, condition distribution will be one hundred (100) to a corresponding state.



Existing Deck/Slab Elements

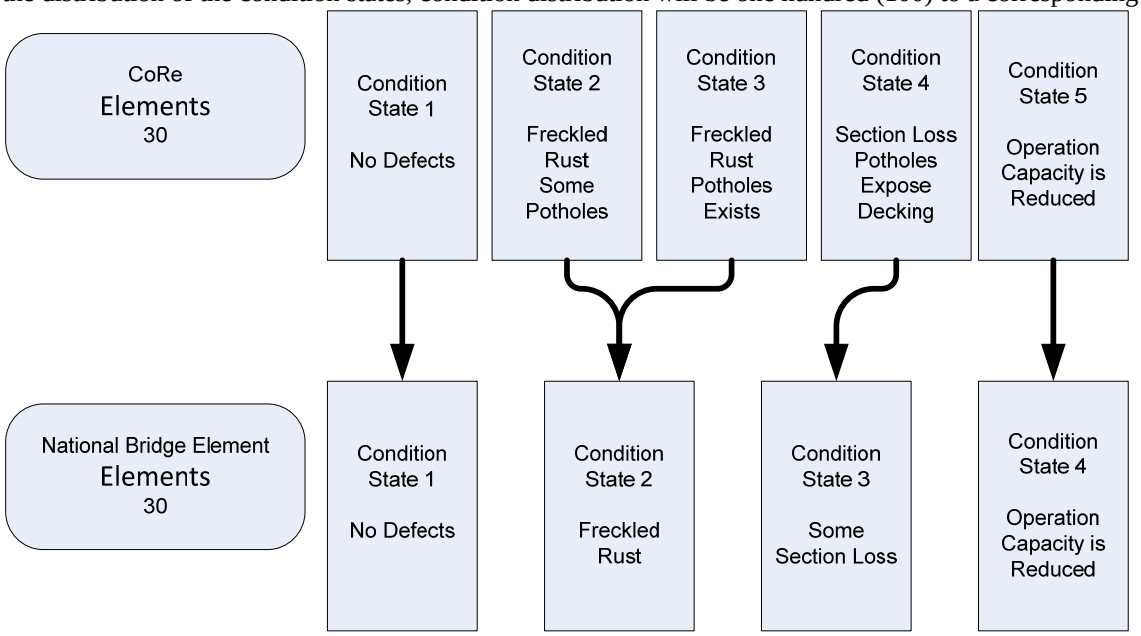
| Element Number | CS 1 | CS 2 | CS 3 | CS 4 | CS 5 |
|---|---|---|---|---|---|
| 28,29 | 0 | 0 | 0 | 100 | 0 |

New NBE Element

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 28,29 | 0 | 0 | 100 | 0 |

*Example Deck 5 – Orthotropic Deck Elements Only*

This example will cover the orthotropic elements. The method of mapping the condition language is the same as the grid deck system. The mapping of condition states one (1) and five (5) correspond to condition of the elements new and failure states. Since the new language removes the coating system from the structural evaluation. With this removal, condition states two (2) and three (3) from the CoRe language are identical. These states will map to condition state two (2). The remaining condition state four (4) will map to three (3). Since there is no way to find the distribution of the condition states, condition distribution will be one hundred (100) to a corresponding state.




Existing Deck/Slab Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 | CS 5 |
|---|---|---|---|---|---|
| 30 | 0 | 0 | 0 | 100 | 0 |

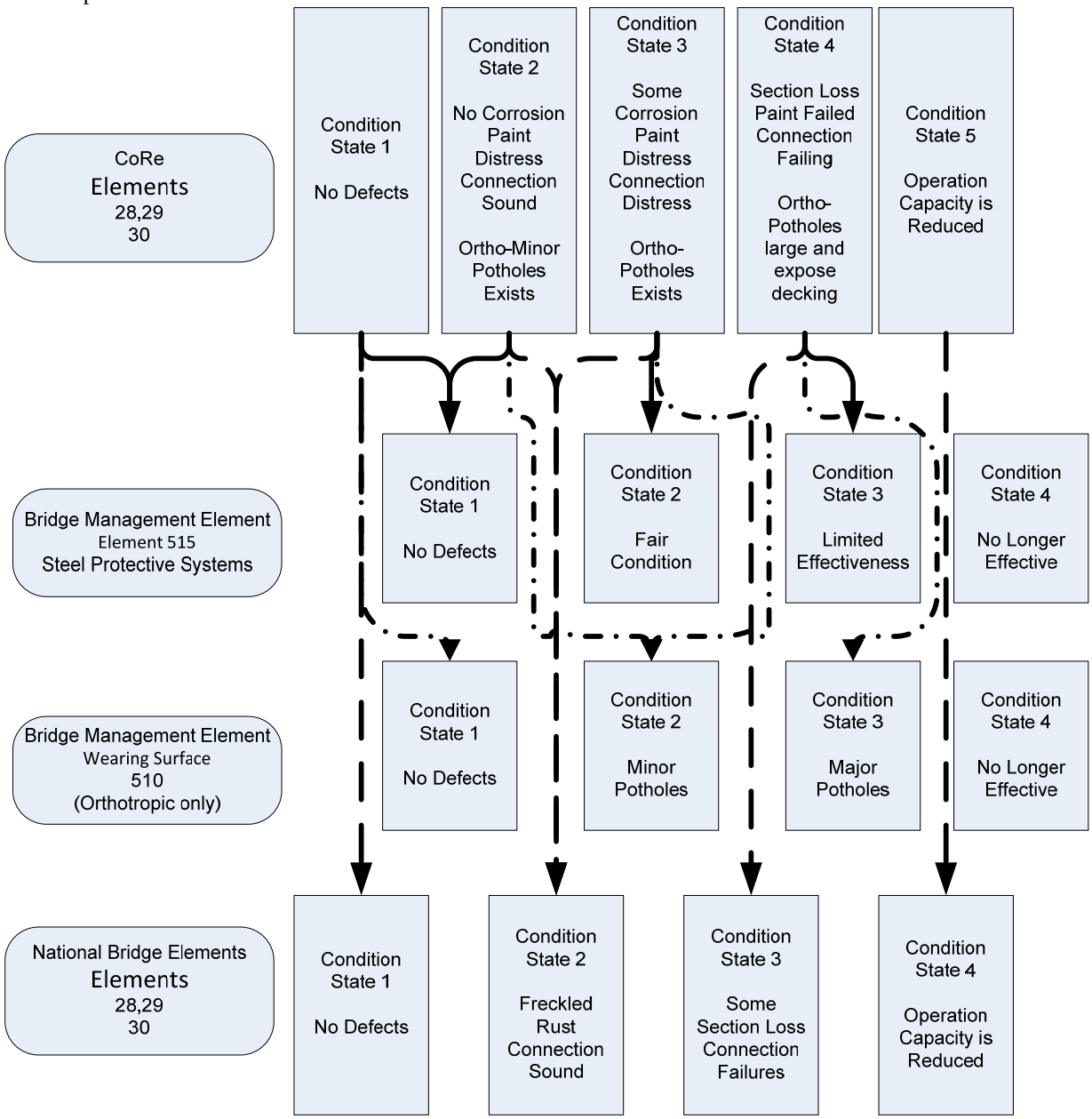
New NBE Element

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 30 | 0 | 0 | 100 | 0 |

*Example Deck 5 – Grid and Orthotropic Deck Elements with Coating System and Wearing Surfaces*

This example will cover the NBE and BME elements need to convert an orthotropic system into the components. This example will hold true for gridded systems except for the wearing surface.
Mapping for this is similar to the concrete. Consider the condition of the structural element first. Since this is a unitary condition element, all of the condition states will be one hundred (100) percent initially for migrating. The bridge in question has a condition state CoRe condition state three (3) with paint and riding surfacing and the mapping of conditions will reflect the language and not field conditions. The migration will include addition of two BME elements. The first is the paint condition and the second is the riding surface. Paint condition will map to

condition state four (4) since there is bare metal. The riding surface has the existence of pothole, but none of size. This mapping will be condition state two (2). These new elements will be associated with the structural element, 30 Orthotropic Deck.




Existing Deck/Slab Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 | CS 5 |
|---|---|---|---|---|---|
| 30 | 0 | 0 | 0 | 100 | 0 |

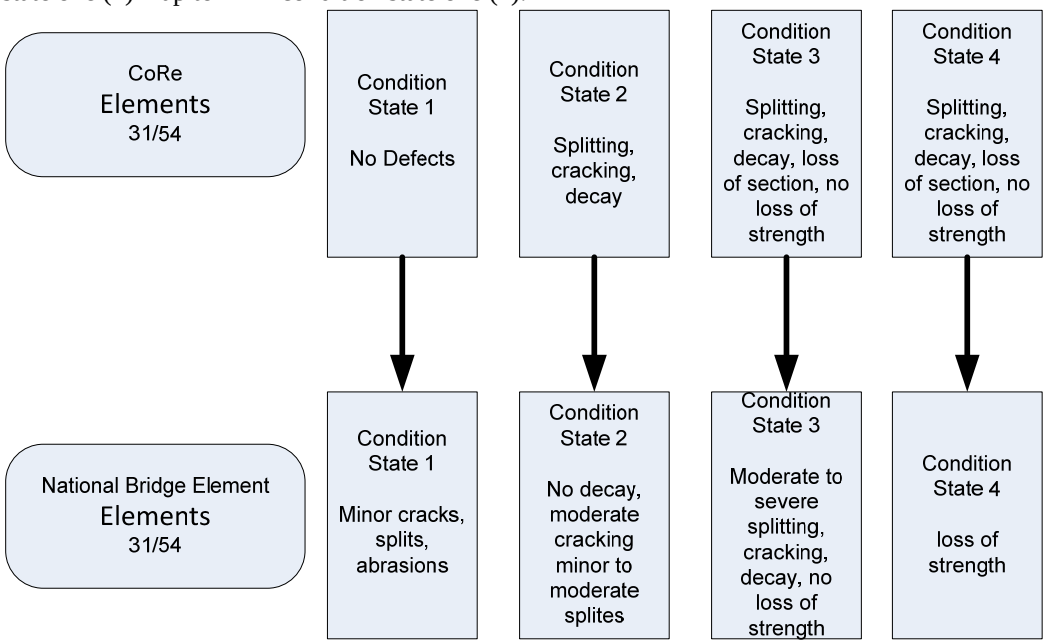
New NBE and BME Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 30 Orthotropic | 0 | 0 | 100 | 0 |
| 510 Wearing Surface | 0 | 100 | 0 | 0 |
| 515 Steel Protective Coating | 0 | 0 | 0 | 100 |

### D.1.3 Timber

*Example Deck 6 – Grid Deck Elements Only*

Since timber elements have only four states, the mapping from CoRe to NBE is one-to-one. That is to say condition state one (1) map to NBE condition state one (1).




Existing Deck/Slab Elements

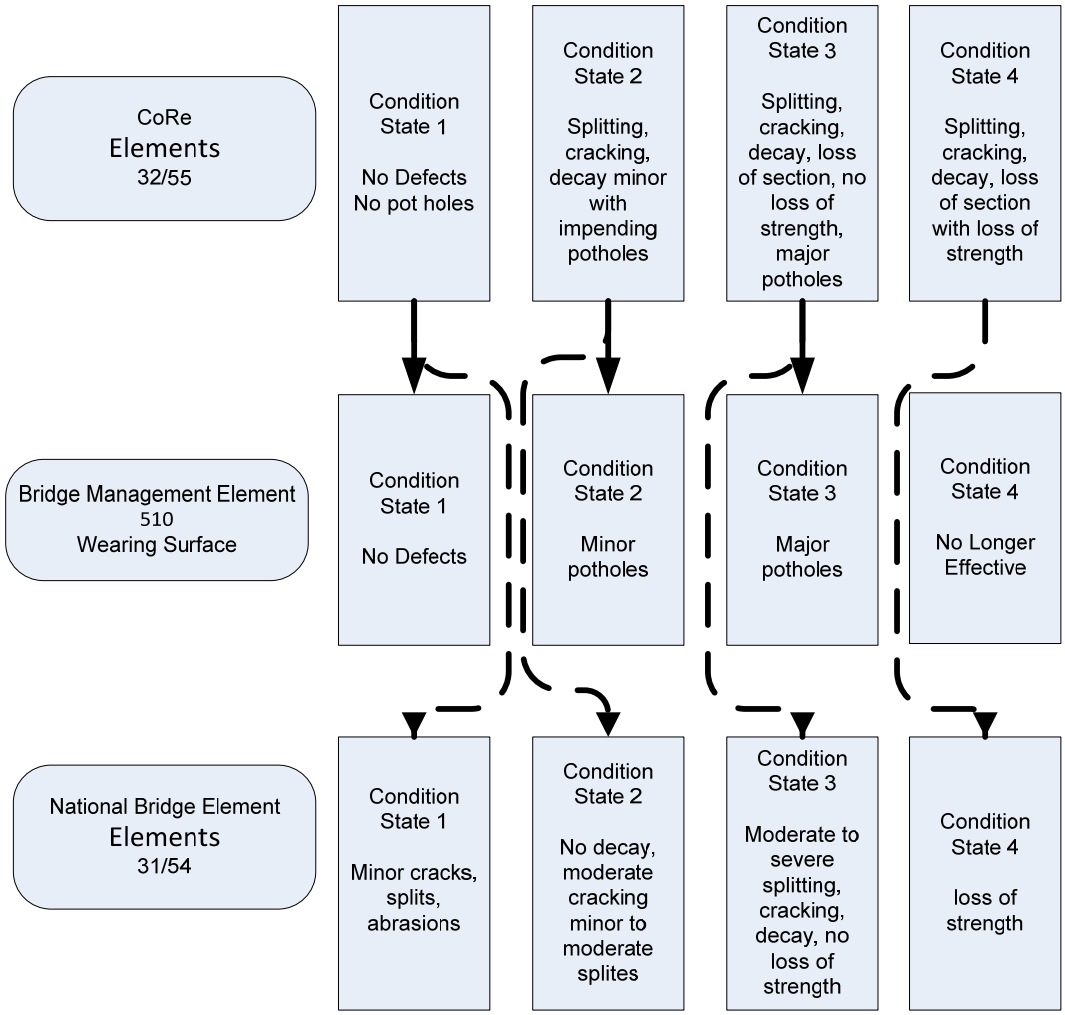
| Element Number | CS 1 | CS 2 | CS 3 | CS 4 | CS 5 |
|---|---|---|---|---|---|
| 31, 54 | 0 | 0 | 0 | 100 | 0 |

New NBE Element

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 31, 54 | 0 | 0 | 100 | 0 |

*Example Deck 7 – Timber Deck with Wearing Surface*

Since timber elements have only four states, the mapping from CoRe to NBE is one-to-one. That is to say condition state one (1) map to NBE condition state one (1). The language for the wearing surface follows the same logic, CoRe state one (1) to state BME state one (1).




Existing Deck/Slab Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 | CS 5 |
|---|---|---|---|---|---|
| 32, 55 | 0 | 0 | 0 | 100 | 0 |

New NBE Element

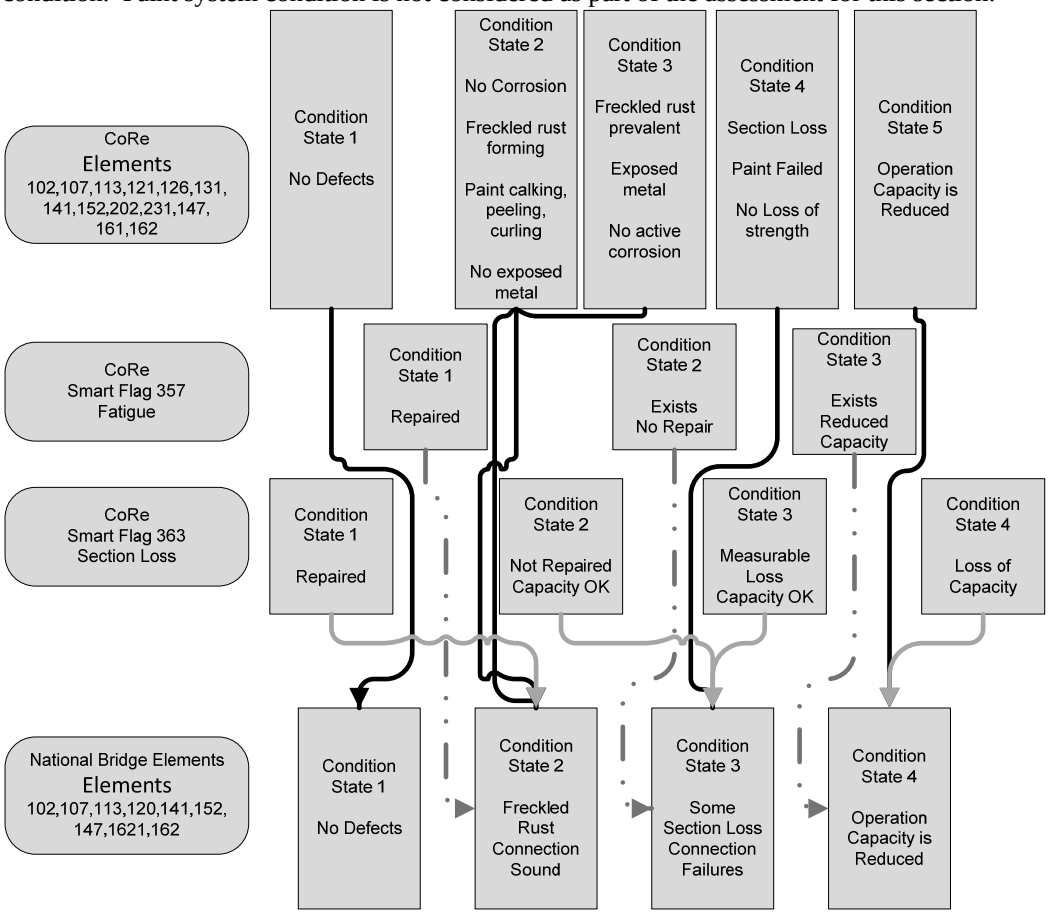
| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 31, 54 | 0 | 0 | 100 | 0 |
| 510 Wearing Surface | 0 | 0 | 100 | 0 |

## D.2 Superstructure, Substructure and Culvert (SSC) Elements

The elements in this section have all of the same characteristics. This includes condition descriptions, condition states, and smart flag applications. The elements are grouped by specific material types that include steel, prestress concrete, mild steel reinforced concrete and timber.

### D.2.1 Steel

*Example SSC 1 – Painted Steel NBE Only*
The existing element condition description is based on paint and the corrosion of the steel after paint failure. The mapping of this element is based on the onset of rust, exposure of the steel and the loss of steel section. The consideration of the smart flags; fatigue and section loss must be considered when mapping to NBE descriptions. As in previous examples, the mapping will need to consider the worst condition(s) first and map back to the best condition. Paint system condition is not considered as part of the assessment for this section.




Existing SSC Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 | CS 5 |
|---|---|---|---|---|---|
| 102,107,113,121,126,131, 141,152,202,231,147, 161,162 | 10 | 30 | 10 | 50 | 0 |

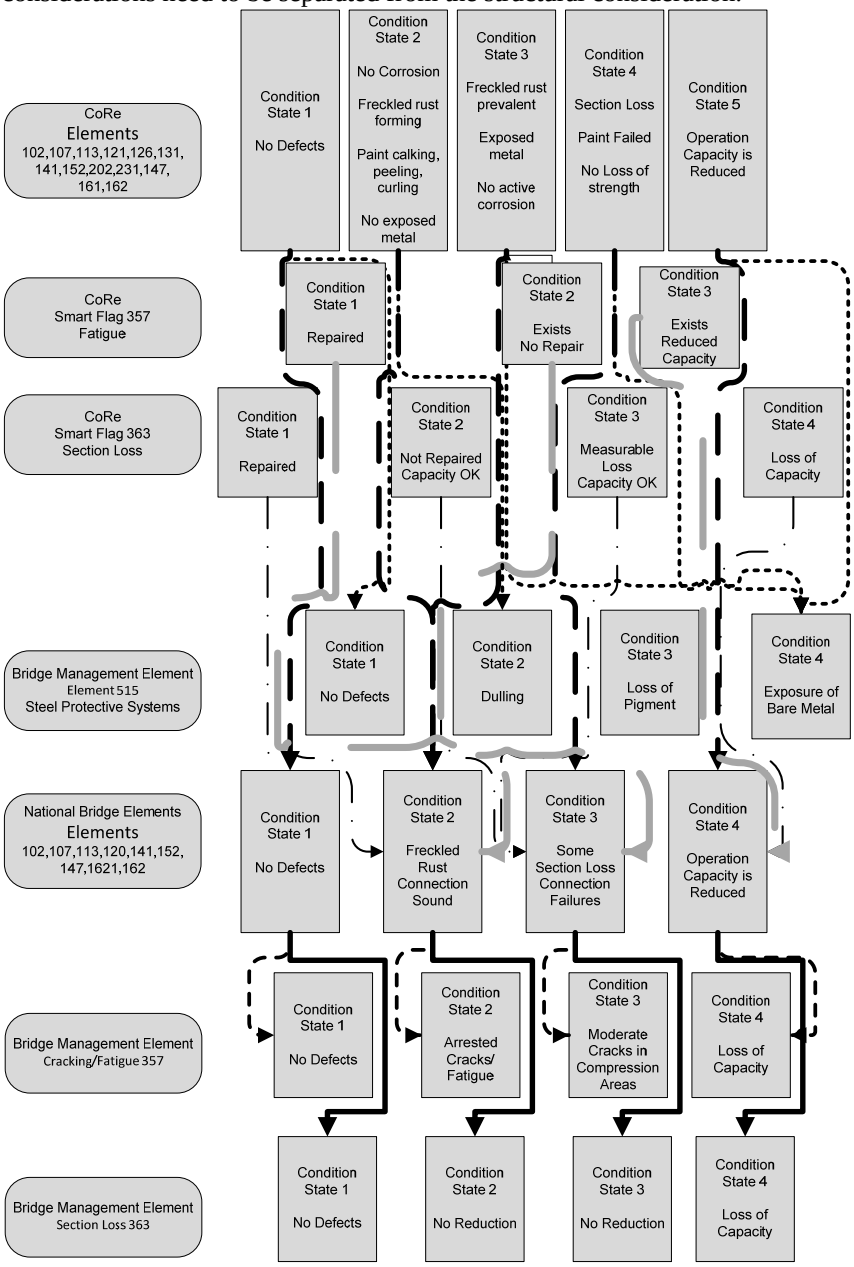
New NBE Element

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 102,107,113,121,126,131, 141,152,202,231,147, | 10 | 40 | 50 | 0 |

| | | | | |
|---|---|---|---|---|
| 161,162 | | | | |

*Example SSC 2 – Painted Steel NBE and BME*

The existing element condition description is based on paint and the corrosion of the steel after paint failure. The mapping of this element is based on the onset of rust, exposure of the steel and the loss of steel section. The consideration of the smart flags; fatigue and section loss must be considered when mapping to NBE descriptions. As in previous examples, the mapping will need to consider the worst condition(s) first and map back to the best condition. The introduction of the smart flags will adjust the quantities in various states because the CoRe flags are bridge level and will need to be applied at a one hundred (100) percent in a given condition state. Paint system considerations need to be separated from the structural consideration.



Existing SSC Elements

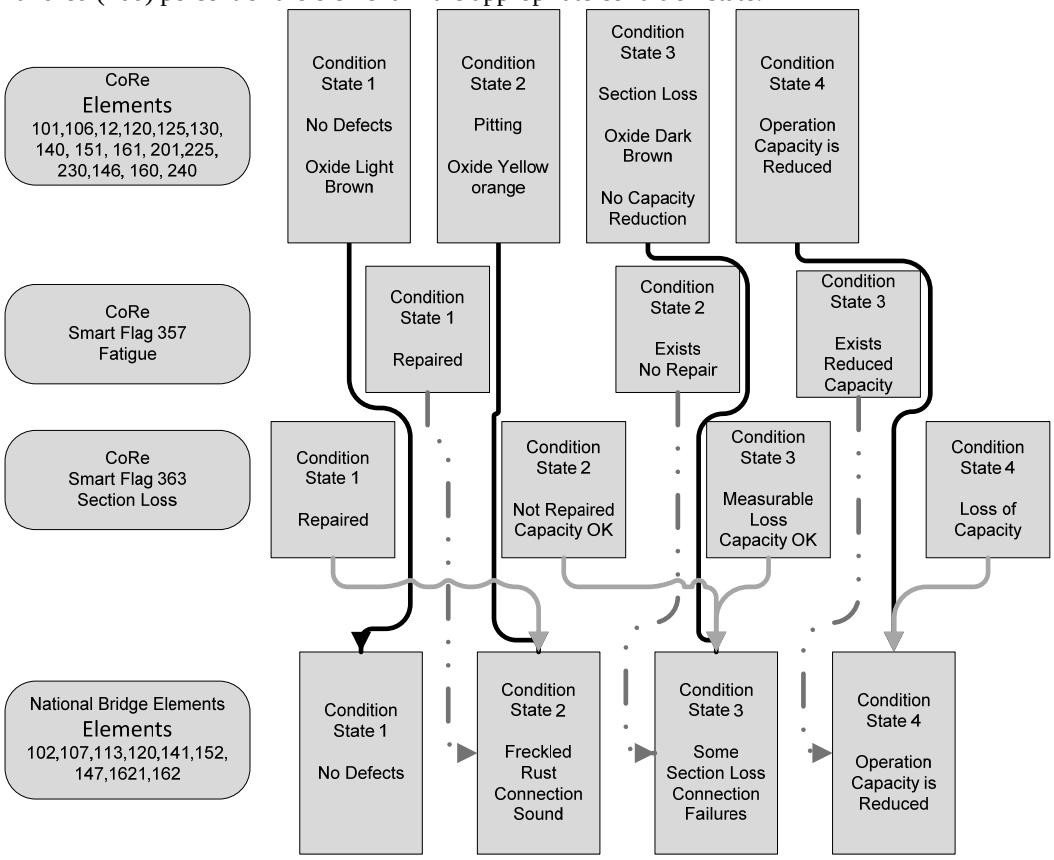
| Element Number | CS 1 | CS 2 | CS 3 | CS 4 | CS 5 |
|---|---|---|---|---|---|
| 102,107,113,121,126,131, 141,152,202,231,147, 161,162 | 10 | 30 | 10 | 50 | 0 |
| 357 | 0 | 100 | 0 | X | X |
| 363 | 0 | 0 | 100 | 0 | X |

New NBE and BME Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 102,107,113,121,126,131, 141,152,202,231,147, 161,162 | 0 | 0 | 100 | 0 |
| 515 | 10 | 0 | 40 | 50 |
| 357 | | | X | |
| 363 | | | X | |

*Example SSC 3 – Unpainted Steel NBE Only*

The CoRe unpainted steel elements have only four condition states. The mapping from element to element is a one-to-one relationship. The use of the CoRe smart flags will cause an adjustment in the final quantity distributions. The CoRe element condition information is primarily based on the weathering steel condition. The CoRe smart flag is a unitary computation and is not associated to an element condition state, the condition mapping will be one hundred (100) percent of the element in the appropriate condition state.



Existing SSC Elements

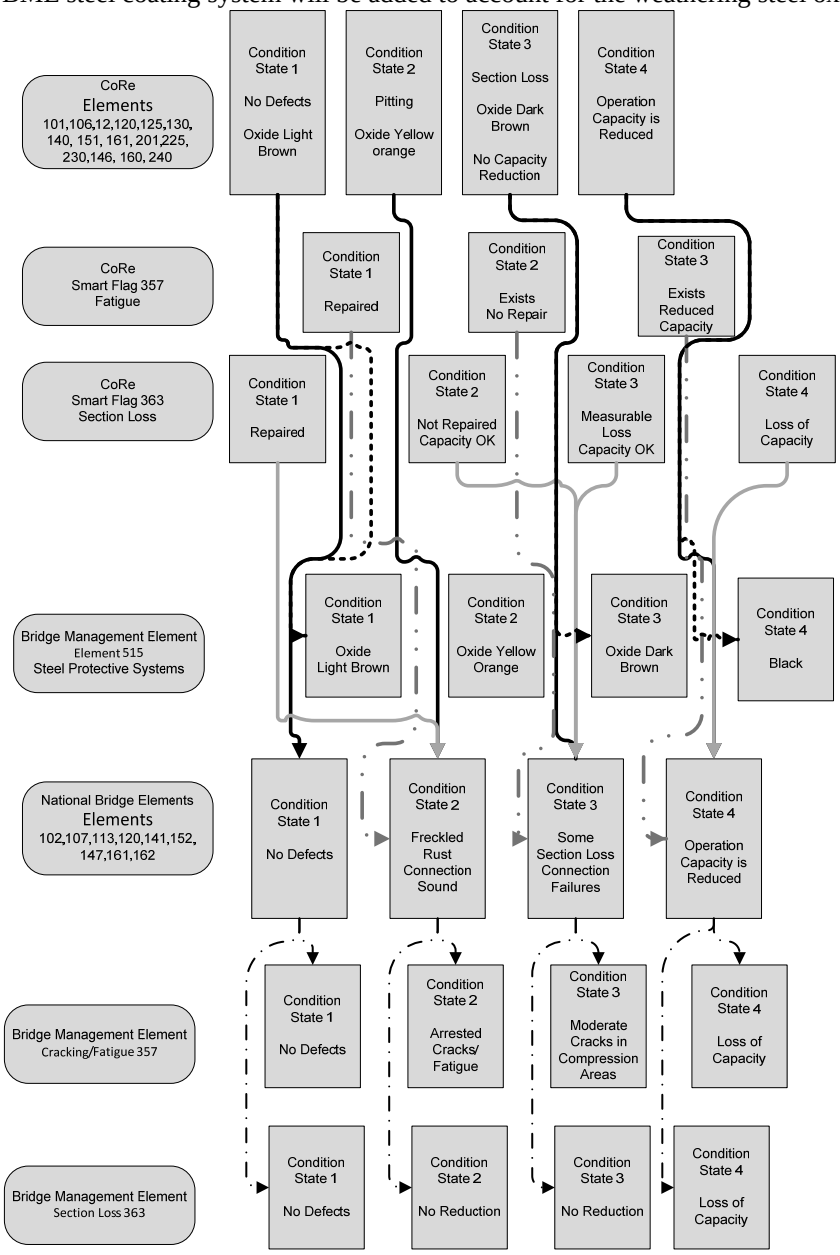
| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 101,106,12,120,125,130, 140, 151, 161, 201,225, 230,146, 160, 240 | 10 | 40 | 0 | 50 |

New NBE and BME Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 101,106,12,120,125,130, 140, 151, 161, 201,225, 230,146, 160, 240 | 10 | 30 | 10 | 50 |

*Example SSC 4 – Unpainted Steel NBE and BME Elements*

The CoRe unpainted steel elements have only four condition states. The mapping from element to element is a one-to-one relationship. The use of the CoRe smart flags will cause an adjustment in the final quantity distributions. The CoRe element condition information is primarily based on the weathering steel condition. In this example the BME steel coating system will be added to account for the weathering steel oxide film



Existing SSC Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 101,106,12,120,125,130, 140, 151, 161, 201,225, 230,146, 160, 240 | 10 | 30 | 10 | 50 |
| 363 | | | 1 Ea | |

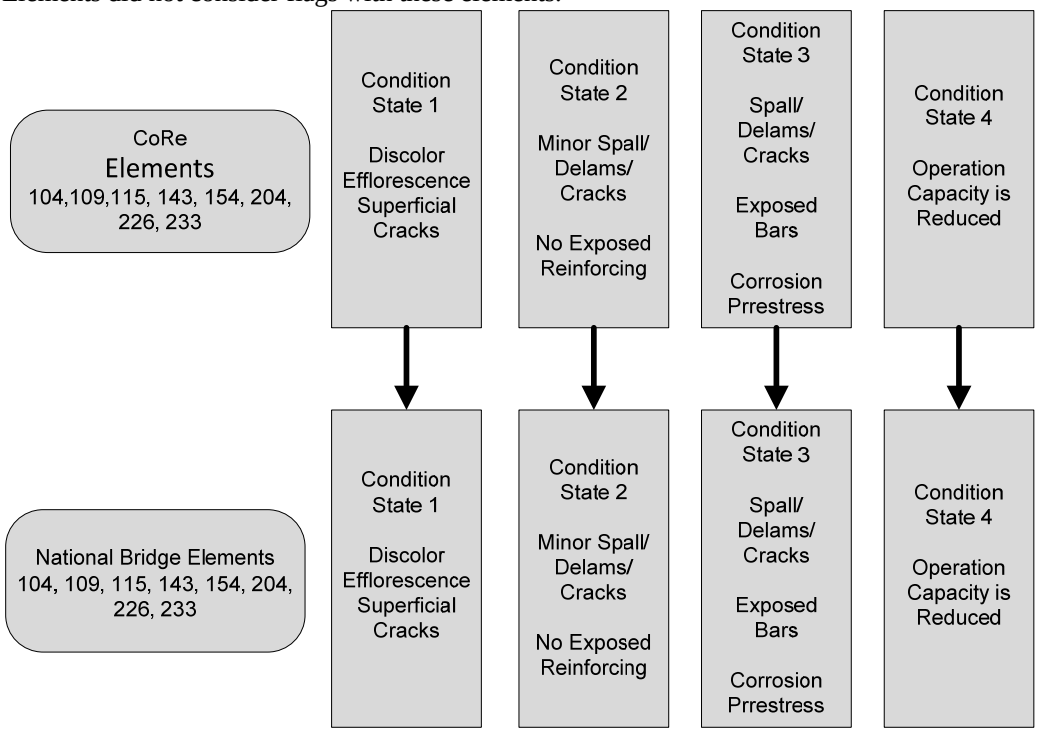
New NBE and BME Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 101,106,12,120,125,130, 140, 151, 161, 201,225, 230,146, 160, 240 | 10 | 30 | 10 | 50 |
| 515 | 10 | 30 | 10 | 50 |
| 363 | | | X | |

### D.2.2 Concrete

*Example SSC 5 – Prestress BME Only*

This element is a four condition state element. The language between CoRe and NBE has little variation. The mapping is one-to-one without consideration of smart flags. Smart flags were not considered because CoRe Elements did not consider flags with these elements.




Existing SSC Elements

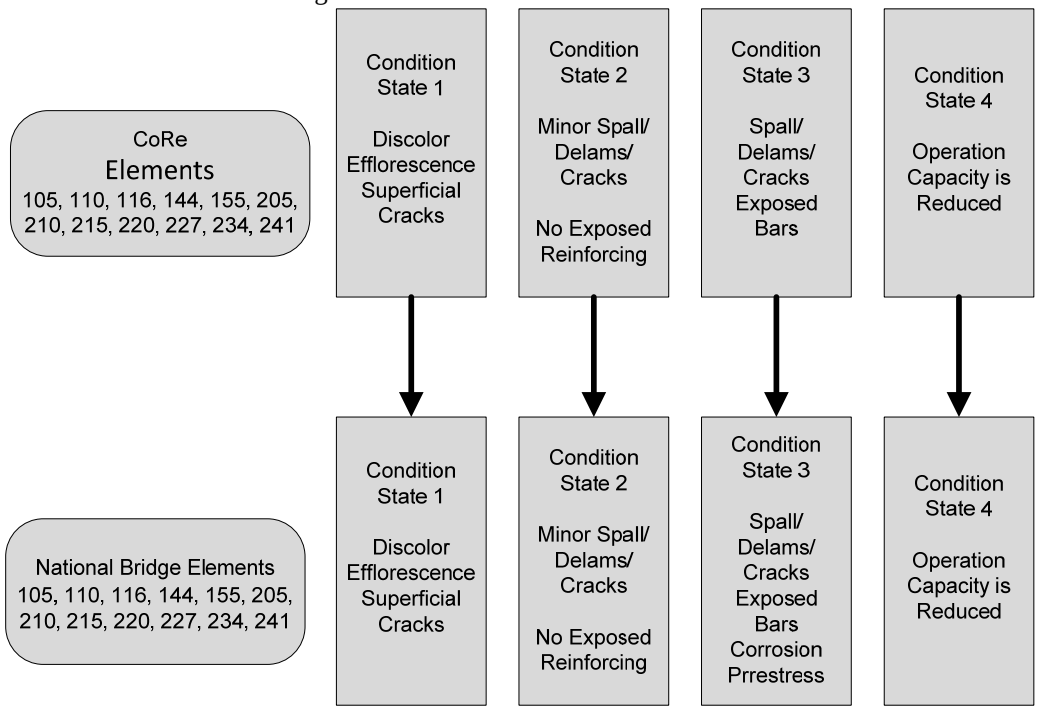
| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 104,109,115, 143, 154, 204, 226, 233 | 10 | 40 | 0 | 50 |

New NBE and BME Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 104,109,115, 143, 154, 204, 226, 233 | 10 | 40 | 0 | 50 |

*Example SSC 6 – Mild Steel Reinforced Concrete BME Only*

This element is a four condition state element. The language between CoRe and NBE has little variation. The mapping is one-to-one without consideration of smart flags. Smart flags were not considered because CoRe Elements did not consider flags with these elements.




Existing SSC Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 105, 110, 116, 144, 155, 205, 210, 215, 220, 227, 234, 241 | 50 | 40 | 10 | 0 |

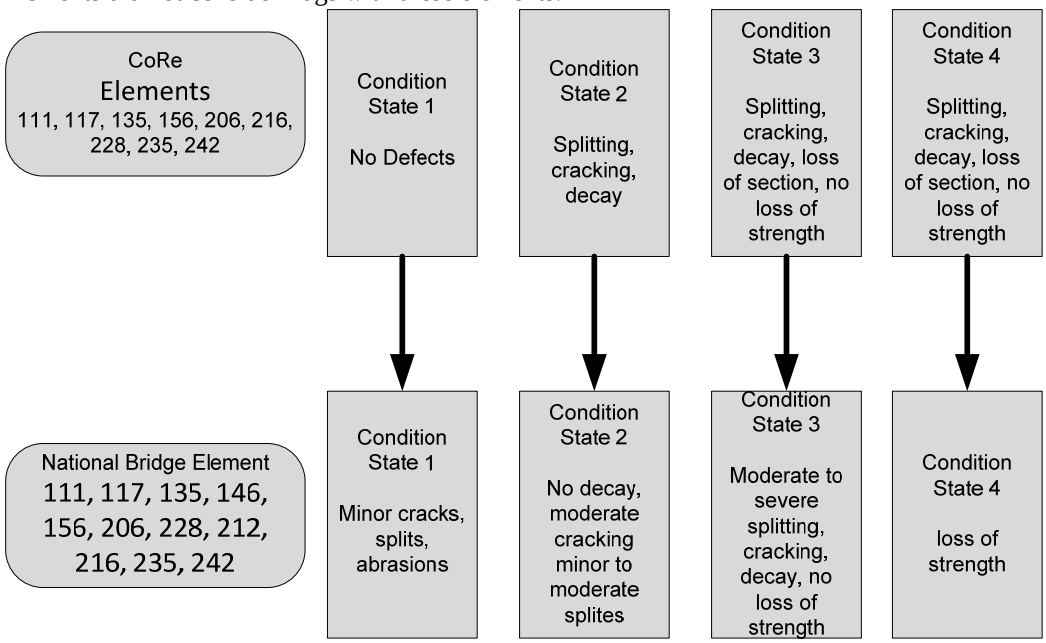
New NBE and BME Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 105, 110, 116, 144, 155, 205, 210, 215, 220, 227, 234, 241 | 50 | 40 | 10 | 0 |

### D.2.3 Timber

*Example SSC 7 – Timber BME Only*

This element is a four condition state element. The language between CoRe and NBE has little variation. The mapping is one-to-one without consideration of smart flags. Smart flags were not considered because CoRe Elements did not consider flags with these elements.




Existing SSC Elements

| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 111, 117, 135, 156, 206, 216, 228, 235, 242 | 50 | 40 | 10 | 0 |

New NBE and BME Elements

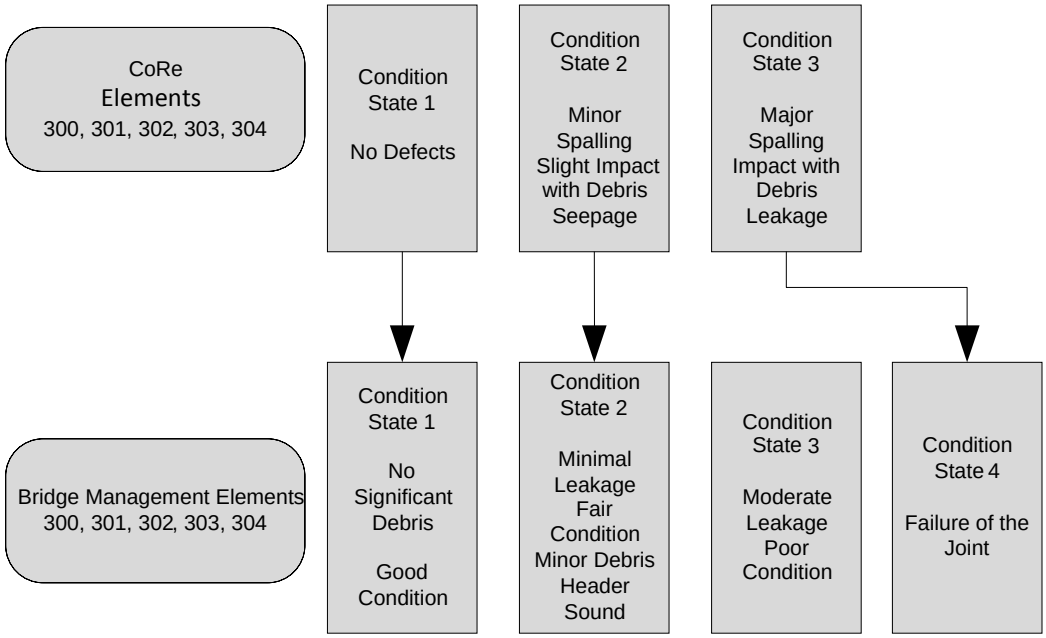
| Element Number | CS 1 | CS 2 | CS 3 | CS 4 |
|---|---|---|---|---|
| 111, 117, 135, 156, 206, 216, 228, 235, 242 | 50 | 40 | 10 | 0 |

## D.3 Other Elements

Non structural elements that need attention for conversion from the existing CoRe elements to the NBE elements are joints, bearings and traffic rails.

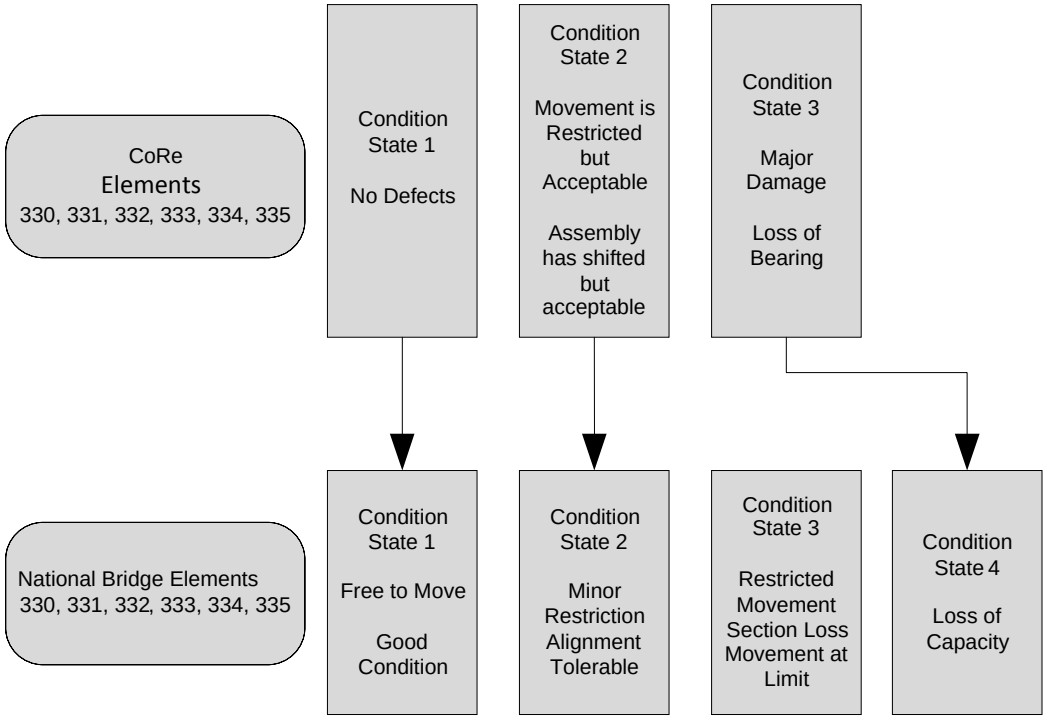
### D.3.1 Joints

Joint function is diverse as the construction. All joints have basic function of absorbing deck movement and protecting the superstructure and substructure elements from moisture and chemicals. The existing CoRe elements have three (3) state definitions. The BME requires the there are four (4) condition states. The mapping of these states is shown in mapping diagram. BME condition three (3) does not have a direct mapping from CoRe condition to the new elements.



### D.3.2 Bearings

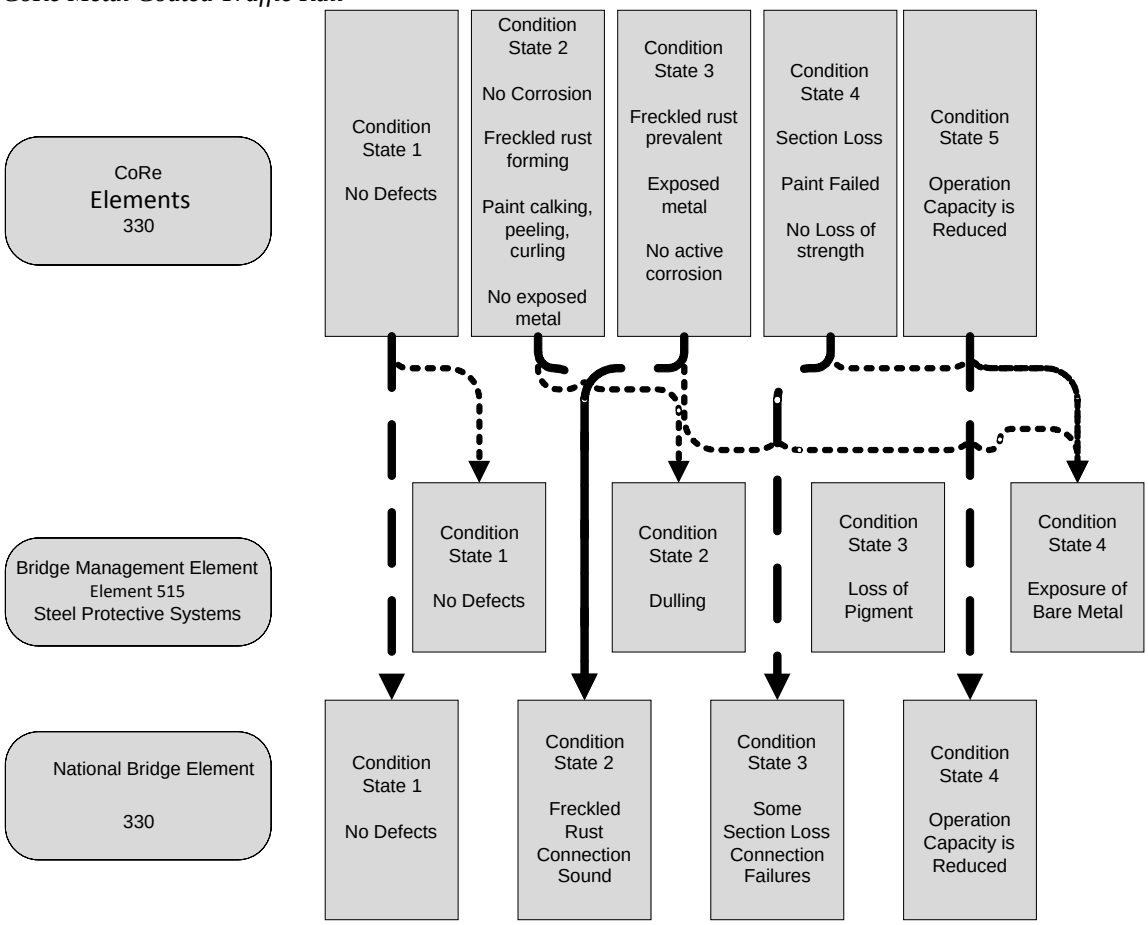
Bearing type and function are diverse as the construction. All bearings have basic function of absorbing superstructure movement. The existing CoRe elements have three (3) state definitions. The NBE requires the there are four (4) condition states. The mapping of these states is shown in mapping diagram. NBE condition three (3) does not have a direct mapping from previous condition to the new elements.



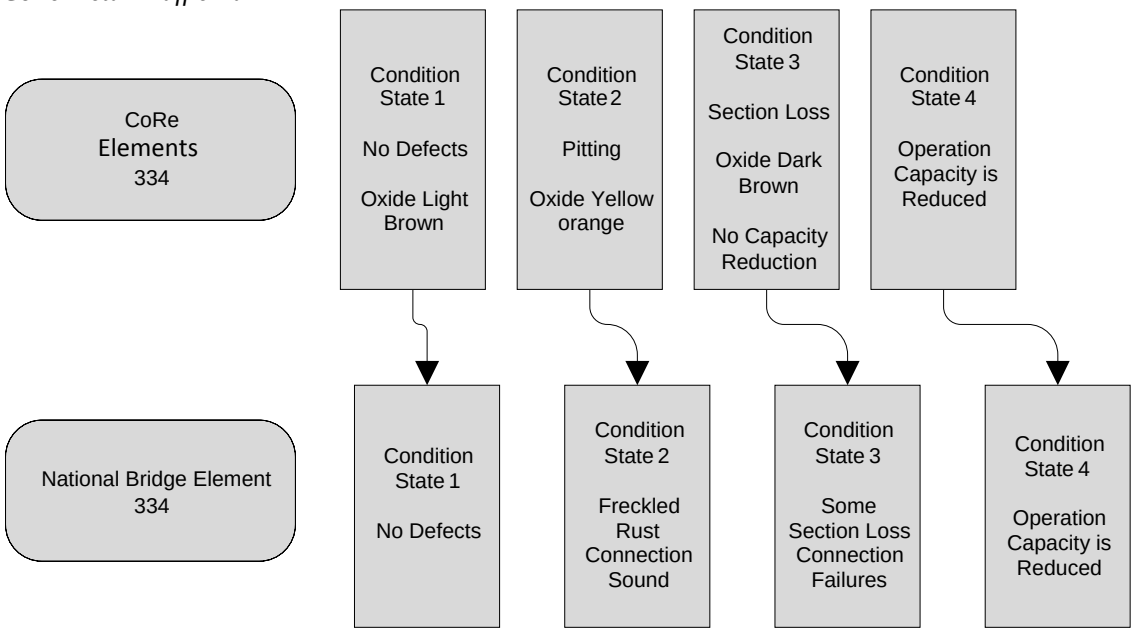
### D.3.3 Traffic Rails

Traffic rails follow a four state conversion. Steel, reinforced concrete and timber traffic rails follow the mapping used for superstructure, substructure and culvert mapping and will map four states one-to-one. Coated metal is the exception. This element is a five (5) state element and will need to be dividing into structural and protective bridge management elements. Examples for these conversions were discussed in previous sections.

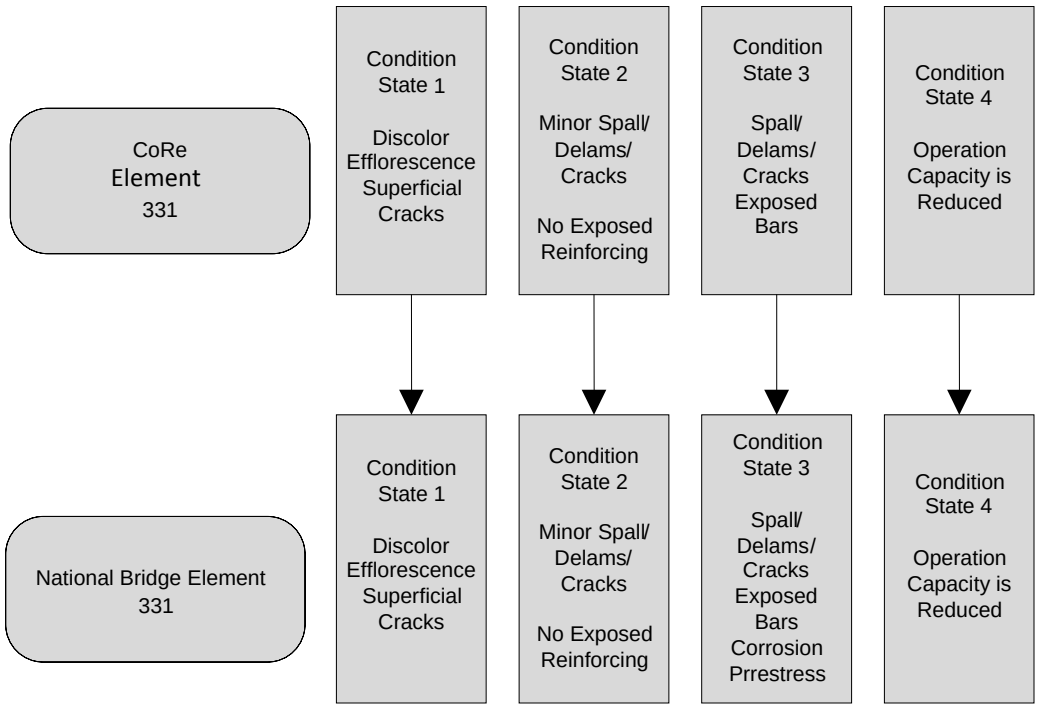
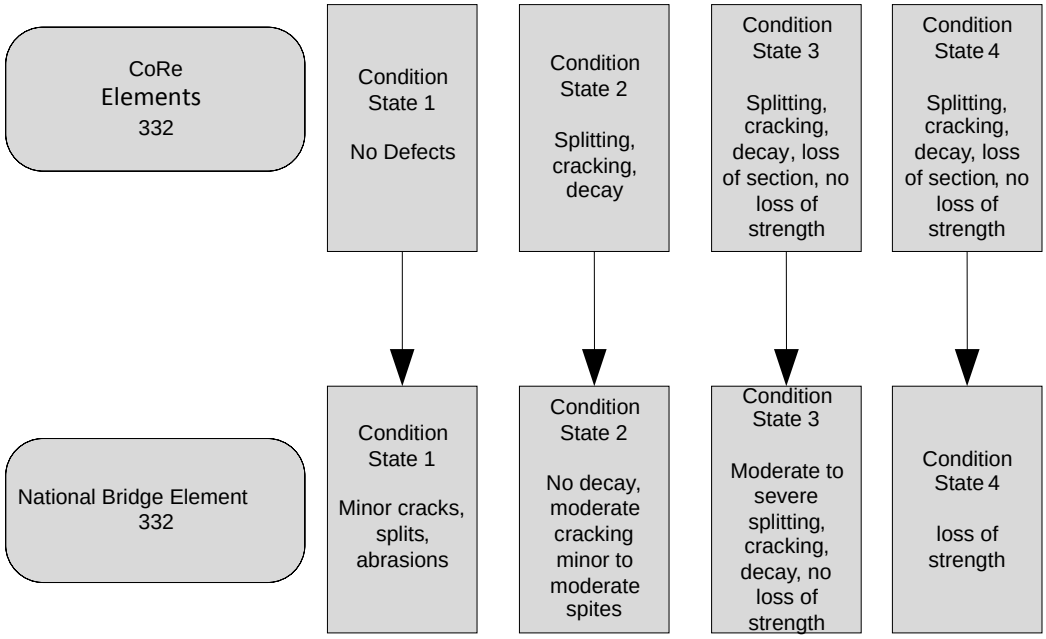
*CoRe Metal Coated Traffic Rail*



*CoRe Metal Traffic Rail*




*CoRe Reinforced Concrete Traffic Rail*



*Timber Traffic Rail*