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2.6 ROADWAY AND APPURTENANCES

2.6.1 Introduction

Bridge roadway and appurtenances refer to bridge related items that are not part of the deck, superstructure or substructure. The bridge will not collapse in the absence of these items. However, they are required for safety and serviceability. Roadways are the approach roadways located on either end of the bridge. Appurtenances are the bridge railings (parapets), expansion joints, protective coatings, and strengthening or repair systems.

2.6.2 Approaches

The primary function of the approach is to provide a smooth transition between the roadway pavement and the bridge deck. This smooth transition decreases the impact forces on the bridge superstructure and therefore increases bridge safety, as well as driver comfort. The length of approach is a judgment call, but in Wisconsin, the normal distance to rate would be from the abutment backwall to the nearest approach pavement joint. If the extent of the approach is unclear, inspect approximately 20 feet from the end of the bridge. The approach roadway width includes the shoulders if the paved shoulders are finished in concrete or bituminous pavement.

The pavement structure varies with the type of approach roadway. For bituminous approaches, the pavement structure consists of a bituminous wearing surface and either a concrete or bituminous sub base. For concrete approaches, it consists of a concrete slab with an aggregate sub base and a relief joint. The subgrade material for both types of approaches is the prepared and compacted soil or gravel immediately beneath the approach.

Vertical settlement is caused by the consolidation of the subgrade materials. Settlement is especially a problem near the abutment. Heave or uplift can also occur due to rotation of the abutment or expansion of frozen subgrade material. In addition, erosion can be a factor for failing approaches due to poor drainage along the edges of the roadway and bridge structure. Once erosion starts along the edges of the roadway, undermining can occur which will lead to further settlement of the approach slab. In certain instances, flood water can cause scour around the back side of the abutment. If evidence of flooding is apparent, special attention should be paid to ensure the backside of the abutment is fully protected.

The riding surface should be smooth, free of potholes, and properly sloped for drainage. Embankment slopes along the roadway shoulder should have adequate vegetation to provide erosion control. Roadway inlets located in the approach area should be in good condition and fully operational. Joints between the approach and the abutment backwall should be examined. Some of these joints are designed for thermal movement. During an inspection, a determination should be made whether or not there is adequate clearance to provide for thermal movement. If the joint was designed for a water seal, determine if the seal is adequate to prevent leakage.

A structural concrete approach is a concrete slab that bears on the abutment at one end. The opposite end bears on a concrete grade beam (a strip footing running the width of the approach). In Wisconsin, the structural approach slab is typically dowelled into the abutment creating a rigid connection. These types of concrete approaches are either reinforced or prestressed, and are designed to span between the abutment and grade beam. These types

of approaches are used because the approach fill is difficult to compact in the vicinity of an abutment and may settle over time. In a sense, this approach type is “a bridge to the bridge”.

Concrete structural approach slabs will always have a grade beam. Non-structural approach slabs will not have a grade beam, that is non-structural approach slabs rest on the paving notch at the abutment and on the approach fill adjacent to the bridge. Non-structural approach slabs may or may not be reinforced. If they are not reinforced or prestressed, extensive cracking may take place if the approach fill settles. The distinction between structural approach slabs and non-structural approach slabs is not always obvious and will need to be determined based off of plans prior to field activities As a general rule, more recently constructed or reconstructed state highway bridges carrying high traffic volumns will have a structural approach slab resting. Older state highway bridges and most non-state highway bridges will have non-structural approach slabs.

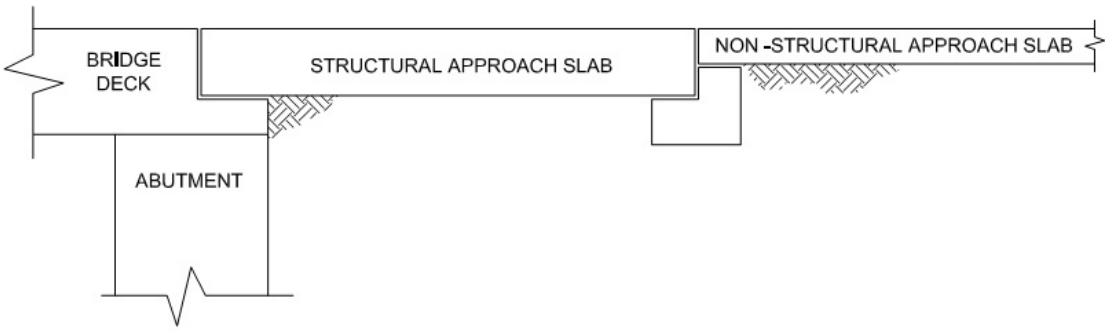

Figure 2.6.2.1-1 Structural Approach Slab Diagram

Concrete approaches on concrete roadways typically use a pavement relief joint between the approach and roadway pavement. The relief joint is a strip of asphalt or filler material that compresses as the roadway pavement expands or migrates towards the bridge. Compression of this relief joint minimizes the roadway pavement from pushing on the approach and abutment backwall.

A concrete approach may be completely overlaid with bituminous asphalt. Similar to bridge decks, the approach slabs are rated based on all exposed surfaces. In the instances of bituminous asphalt overlays, the condition of the bituminous asphalt should be inspected for signs of deterioration that would lead to the conclusion that the concrete approach slab has failed.

2.6.2.1 Prestressed Concrete Structural Approach Slab (Element 320)

Both Elements 320 and 321 are for structural approach slabs only. Non-structural approach slabs will be coded under the applicable Assessment. Structural approach slabs will have one end resting on the abutment paving notch, and the other end resting on a grade beam.

Element Level Inspection

On the inspection report form, a prestressed concrete structural approach slab is recorded in units of square feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the approach slabs condition and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of concrete approaches should include the following items:

- Looking for settlement or heaving of the approach roadway. If settlement of the slab or grade beam has occurred, there may be evidence of cracking.
- Examining the joint between the approach and the abutment backwall. Some of these joints are designed for thermal movement. A determination should be made whether or not there is adequate clearance to provide for this movement. If the joint was designed for a water seal, determine if the seal is adequate to prevent leakage.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Delaminations/Spalls/Patched Areas (1080)
- Exposed Prestressing (1100)
- Cracking (PSC) (1110)
- Abrasion/Wear (PSC/RC) (1190)
- Precast Concrete Connections (8906)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the

severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.2.2 Reinforced Concrete Structural Approach Slab (Element 321)

Both Elements 320 and 321 are for structural approach slabs only. Non-structural approach slabs will be coded under the applicable Assessment. Structural approach slabs will have one end resting on the abutment paving notch, and the other end resting on a grade beam.

Figure 2.6.2.2-1 Concrete Approach with Wide Cracks – Condition State 3

Element Level Inspection

On the inspection report form, a reinforced concrete structural approach slab is recorded in units of square feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the approach slabs condition and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of concrete approaches should include the following items:

- Looking for settlement or heaving of the approach roadway. If settlement of the slab or grade beam has occurred, there may be evidence of cracking.

- Examining the joint between the approach and the abutment backwall. Some of these joints are designed for thermal movement. A determination should be made whether or not there is adequate clearance to provide for this movement. If the joint was designed for a water seal, determine if the seal is adequate to prevent leakage.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Delaminations/Spalls/Patched Areas (1080)
- Exposed Rebar (1090)
- Cracking (RC) (1130)
- Abrasion/Wear (PSC/RC) (1190)
- Precast Concrete Connections (8906)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.3 Wearing Surfaces

Wearing surfaces are placed on top of the deck and protects the deck and provides a smooth riding surface. Wearing surfaces are incorporated in many new deck designs and are also a common repair or protective procedure for decks. The wearing surface elements extends to a depth of the bottom of the top mat of deck/slab reinforcement.

2.6.3.1 Wearing Surface – Other (Element 510)

This element is for all decks/slabs that have overlays other than the ones described below in this section. Examples would be FRP overlays, timber running planks, steel plates in wheel paths, etc.

Element Level Inspection

On the inspection report form, wearing surfaces are recorded in units of square feet. The square footage of a wearing surface does not need to equal the square footage of the deck. The area of the wearing surface will be limited to an equal or smaller area. Examples of smaller area occasions are timber decks with raised medians or raised sidewalks, which would not be included in the wearing surface element. In this case, only the section of wearing surface between the raised median/sidewalk would be counted as square feet under this element. In addition, bridge decks with concrete parapets would be measured similarly, between parapets and/or raised medians/sidewalks, i.e. only the driving surface. The area under the concrete parapet would not be counted towards the total area under this element.

Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Delamination/Spall/Patched Area/Pothole – Wearing Surface (3210)
- Crack – Wearing Surface (3220)
- Abrasion, Wear, Rutting, or Loss of Friction – Wearing Surface (8911)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.3.2 Wearing Surfaces – Bare (Element 8000)

Decks, slabs, or top flanges without a wearing surface or overlay must have this element added. The top of the deck, slab, or top flange shall be evaluated under this element. This is done for simplicity by eliminating the necessity to overlap top and bottom material defects. By always having an assigned wearing surface to the top surface of a deck and slab element, the inspector and department have the added ability to provide specific maintenance recommendations for both the top and bottom of decks. This element shall be used on constructed decks with integral wearing surfaces placed on top of the deck (i.e. decks measuring approximately 1.5 inches thicker due to a sacrificial wearing surface). Integral wearing surfaces should not be confused with concrete overlays which are separate pours and not monolithic with the deck. Wearing Surface – Bare shall be used when a structural concrete overlay is placed on a deck. A structural overlay is thicker than a typical overlay and has a mat of steel reinforcement. These overlays are structurally tied into the deck making it essentially an extension of the older deck.

This element shall be used for all deck, slab or appropriate top flange elements regardless of construction material except Steel Deck – Open Grid (Element 28). Both the top and bottom condition of the Steel Deck – Open Grid element is easily inspected from either the top or bottom. All other deck and slab elements and those top flanges used as a driving surface without an overlay or wearing surface shall require this element for top surface evaluation.

When evaluating patches in wearing surfaces, the material of the patch will effect whether or not the patch can be considered sound. Patches of differing materials will not be considered sound (i.e. asphalt patch on a concrete overlay). The patch must be of the same material to be considered sound. If the patch and base materials are the same, then the patch can be inspected for delamination or other unsound indications. . If inspection shows a sound patch, the Condition State of the patched area may be raised to Condition State 2.

Element Level Inspection

On the inspection report form, wearing surfaces are recorded in units of square feet. The square footage of a wearing surface does not need to equal the square footage of the deck.

The area of the wearing surface will be limited to an equal or smaller area. Examples of smaller area occasions are timber decks with raised medians or raised sidewalks, which would not be included in the wearing surface element. In this case, only the section of wearing surface between the raised median/sidewalk would be counted as square feet under this element In addition, bridge decks with concrete parapets would be measured similarly, between parapets and/or raised medians/sidewalks, i.e. only the driving surface. The area under the concrete parapet would not be counted towards the total area under this element.

Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Delamination/Spall/Patched Area/Pothole – Wearing Surface (3210)
- Crack – Wearing Surface (3220)
- Abrasion, Wear, Rutting, or Loss of Friction – Wearing Surface (8911)

When steel reinforcing or other reinforcing material becomes exposed through a wearing surface, the wearing surface in that area is no longer considered effective and shall be coded Condition State 4 for the appropriate measurement under defect Delaminiation/Spall/Patched Area/Pothole – Wearing Surface (3210).

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange

- Condition State 4 Severe Red

2.6.3.3 AC Overlay (Element 8511)

This element includes Chip seals.

Placing an Asphalt Concrete (AC) Overlay on top of a cracked or damaged bridge deck is a typical repair. An AC Overlay will typically be 1-3" in depth. AC Overlays will typically be used over distressed concrete or previous overlays to restore a smooth wearing surface. One disadvantage of AC Overlays is that expansion and contraction of the underlying pavement will typically cause cracks that are referred to as reflective cracks in the asphalt.

When evaluating patches in wearing surfaces, the material of the patch will effect whether or not the patch can be considered sound. Patches of differing materials will not be considered sound (i.e. asphalt patch on a concrete overlay). The patch must be of the same material to be considered sound. If the patch and base materials are the same, then the patch can be inspected for delamination or other unsound indications. If inspection shows a sound patch, the Condition State of the patched area may be raised to Condition State 2.

Element Level Inspection

On the inspection report form, wearing surfaces are recorded in units of square feet. The square footage of a wearing surface does not need to equal the square footage of the deck. The area of the wearing surface will be limited to an equal or smaller area. Examples of smaller area occasions are timber decks with raised medians or raised sidewalks, which would not be included in the wearing surface element. In this case, only the section of wearing surface between the raised median/sidewalk would be counted as square feet under this element. In addition, bridge decks with concrete parapets would be measured similarly, between parapets and/or raised medians/sidewalks, i.e. only the driving surface. The area under the concrete parapet would not be counted towards the total area under this element.

Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Delamination/Spall/Patched Area/Pothole – Wearing Surface (3210)

- Crack – Wearing Surface (3220)
- Abrasion, Wear, Rutting, or Loss of Friction – Wearing Surface (8911)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.3.4 AC Overlay and Membrane (Element 8512)

This element includes Polymer Modified Asphalt (PMA) systems.

A membrane can be placed between an AC Overlay and a concrete deck to seal the concrete against salt and water infiltration which can corrode the reinforcing bars and lead to early deterioration of the bridge deck. Membranes are typically used on bridge deck rehabilitation projects. Since these membranes are not visible during the inspection, the inspector will need to review plans/maintenance rehabilitation history to verify the presence of a membrane.

When evaluating patches in wearing surfaces, the material of the patch will effect whether or not the patch can be considered sound. Patches of differing materials will not be considered sound (i.e. asphalt patch on a concrete overlay). The patch must be of the same material to be considered sound. If the patch and base materials are the same, then the patch can be inspected for delamination or other unsound indications. . If inspection shows a sound patch, the Condition State of the patched area may be raised to Condition State 2.

Element Level Inspection

On the inspection report form, wearing surfaces are recorded in units of square feet. The square footage of a wearing surface does not need to equal the square footage of the deck. The area of the wearing surface will be limited to an equal or smaller area. Examples of smaller area occasions are timber decks with raised medians or raised sidewalks, which would not be included in the wearing surface element. In this case, only the section of wearing surface between the raised median/sidewalk would be counted as square feet under this element. In addition, bridge decks with concrete parapets would be measured similarly, between parapets and/or raised medians/sidewalks, i.e. only the driving surface. The area under the concrete parapet would not be counted towards the total area under this element.

Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Delamination/Spall/Patched Area/Pothole – Wearing Surface (3210)
- Crack – Wearing Surface (3220)
- Abrasion, Wear, Rutting, or Loss of Friction – Wearing Surface (8911)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.3.5 Thin Polymer Overlay (Element 8513)

Polymer overlays have strong adhesion to the concrete base underneath and elasticity so they are less susceptible to thermal movements and deflections from loading. These overlays also tend to have a rougher surface that can avert skidding and retain de-icing materials for a longer period of time.

When evaluating patches in wearing surfaces, the material of the patch will effect whether or not the patch can be considered sound. Patches of differing materials will not be considered sound (i.e. asphalt patch on a concrete overlay). The patch must be of the same material to

be considered sound. If the patch and base materials are the same, then the patch can be inspected for delamination or other unsound indications. . If inspection shows a sound patch, the Condition State of the patched area may be raised to Condition State 2.

Element Level Inspection

On the inspection report form, wearing surfaces are recorded in units of square feet. The square footage of a wearing surface does not need to equal the square footage of the deck. The area of the wearing surface will be limited to an equal or smaller area. Examples of smaller area occasions are timber decks with raised medians or raised sidewalks, which would not be included in the wearing surface element. In this case, only the section of wearing surface between the raised median/sidewalk would be counted as square feet under this element. In addition, bridge decks with concrete parapets would be measured similarly, between parapets and/or raised medians/sidewalks, i.e. only the driving surface. The area under the concrete parapet would not be counted towards the total area under this element.

Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Delamination/Spall/Patched Area/Pothole– Wearing Surface (3210)
- Crack – Wearing Surface (3220)
- Abrasion, Wear, Rutting, or Loss of Friction – Wearing Surface (8911)

Condition State Commentary

Appendix ??A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green

- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.3.6 Concrete Overlay (Element 8514)

This type of overlay can be placed on any pavement type, including concrete, asphalt, and composite concrete and asphalt pavements. A concrete overlay can be bonded or unbounded. A bonded concrete overlay will be relatively thin (2-4") and can be used with surface distress exists but the overall structural integrity of the existing concrete still exists. An unbounded concrete overlay will be thicker (4-11") and will perform as a new pavement and the existing pavement will exist as a base. This will typically be used when the structural integrity of the existing pavement is in question.

When evaluating patches in wearing surfaces, the material of the patch will effect whether or not the patch can be considered sound. Patches of differing materials will not be considered sound (i.e. asphalt patch on a concrete overlay). The patch must be of the same material to be considered sound. If the patch and base materials are the same, then the patch can be inspected for delamination or other unsound indications. If inspection shows a sound patch, the Condition State of the patched area may be raised to Condition State 2.

Element Level Inspection

On the inspection report form, wearing surfaces are recorded in units of square feet. The square footage of a wearing surface does not need to equal the square footage of the deck. The area of the wearing surface will be limited to an equal or smaller area. Examples of smaller area occasions are timber decks with raised medians or raised sidewalks, which would not be included in the wearing surface element. In this case, only the section of wearing surface between the raised median/sidewalk would be counted as square feet under this element. In addition, bridge decks with concrete parapets would be measured similarly, between parapets and/or raised medians/sidewalks, i.e. only the driving surface. The area under the concrete parapet would not be counted towards the total area under this element.

Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects.

However, only the controlling defect will be counted in the total element condition state quantity.

- Delamination/Spall/Patched Area/Pothole – Wearing Surface (3210)
- Crack – Wearing Surface (3220)
- Abrasion, Wear, Rutting, or Loss of Friction – Wearing Surface (8911)

When steel reinforcing or other reinforcing material becomes exposed through a wearing surface, the wearing surface in that area is no longer considered effective and shall be coded Condition State 4 for the appropriate measurement under defect Delaminiation/Spall/Patched Area/Pothole – Wearing Surface (3210).

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.3.7 Polyester Concrete Overlay (Element 8515)

When polyester resin is used in Portland Cement Concrete it has as rapid cure time of 2-4 hours, has greater flexural strength than conventional concrete, and is typically 1” thick.

When evaluating patches in wearing surfaces, the material of the patch will effect whether or not the patch can be considered sound. Patches of differing materials will not be considered sound (i.e. asphalt patch on a concrete overlay). The patch must be of the same material to be considered sound. If the patch and base materials are the same, then the patch can be inspected for delamination or other unsound indications. If inspection shows a sound patch, the Condition State of the patched area may be raised to Condition State 2.

Element Level Inspection

On the inspection report form, wearing surfaces are recorded in units of square feet. The square footage of a wearing surface does not need to equal the square footage of the deck. The area of the wearing surface will be limited to an equal or smaller area. Examples of smaller area occasions are timber decks with raised medians or raised sidewalks, which would not be included in the wearing surface element. In this case, only the section of

wearing surface between the raised median/sidewalk would be counted as square feet under this element. In addition, bridge decks with concrete parapets would be measured similarly, between parapets and/or raised medians/sidewalks, i.e. only the driving surface. The area under the concrete parapet would not be counted towards the total area under this element.

Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Delamination/Spall/Patched Area/Pothole/Pothole – Wearing Surface (3210)
- Crack – Wearing Surface (3220)
- Abrasion, Wear, Rutting, or Loss of Friction – Wearing Surface (8911)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.4 Joint Elements

Expansion joints provide for thermal expansion and contraction of the deck and superstructure. The clear opening of the joint should provide for adequate space for movement of the adjacent superstructure elements. Joints also fill the gap between deck and

abutment backwall to provide a smooth ride for vehicles transitioning onto and off the bridge. They must also be durable enough to withstand the abuse from traffic loads, snow plow blades, road debris, sunlight, freeze/thaw, and deicing chemicals.

The primary components of a deck joint are the anchor system, the support system, and the joint material. The concrete on either side of the opening into which the anchorage systems are cast is often called the “header”.

The two major categories of deck joints are closed joints and open joints. Closed joints are designed so that water and debris do not pass through them. The five types of closed joints are strip seals, poured joint seals, compression seal/cellular seal, modular strip seal, and elastomeric expansion seal. Open joints allow water and debris to pass through the joints. The four types of open joints are open/formed joints, finger plate joints, sliding plate joints, and open expansion joints.

Construction joints and longitudinal bridge joints should not be coded under this element. In addition, joints between the deck and non-structural approach slabs shall not be inventoried as a joint. It may be necessary to review bridge plans to distinguish between sealed construction joints and pourable joint seals. Joints will be inventoried when there is a discontinuity in deck reinforcement, superstructure, or if bearings support the adjacent superstructure section and provide room for expansion and contraction. In some cases, there is an expansion joint at the end of the structural approach slab, between the structural and non-structural approaches. If this joint provides room for expansion and contraction, then this joint shall be coded as an element.

2.6.4.1 Strip Seal Expansion Joint (Element 300)

Strip seal expansion joints are commonly used in Wisconsin today. Strip seals are “V” shaped neoprene glands used at expansion joints to prevent water from falling through the joint and corroding the girders, bearings, and other elements below. They are formed with bulbs along their edges that lock and are glued into steel extrusions on either side of the opening. The steel extrusions are anchored to either the deck or backwall.

Single strip seals typically have a normal expansion gap of 4 inches. With superstructure expansion and contraction, the seal folds or opens up while providing a continuous seal across the opening. If there is not enough slack in the gland, the gland may pull out of the anchorage and leak. The gland may also fill with debris and, when compressed, the gland may tear and leak.

Element Level Inspection

On the inspection report form, a strip seal expansion joint is recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element’s state of deterioration and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of strip seal expansion joints should include the following items:

- Checking for debris that has filled the joint. Road debris may contain sharp objects that can puncture or rip the gland when run over by vehicles. It can also prevent proper folding of the gland during superstructure expansion.

- Removing debris from the joint to examine the gland for tears or punctures (if this removal can be done safely).

- Looking for areas where the strip seal has pulled out of the extrusion.

- Examining the backwall and bearing seat for dampness, water stains or debris accumulation that indicate a leak in the strip seal.

- Measuring the opening between steel anchorages and the temperature when the measurement was taken.

- Checking the vertical alignment across the joint. Impact on the bridge is increased when each side of the joint opening is at a different elevation.

- Noting any indiscriminate bituminous overlays that were placed over the joint. This prevents proper joint operation. Asphalt paving over an expansion joint is considered debris impaction.

- Checking to make sure the steel anchorages are secure. Loose anchorages could damage a vehicle.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Leakage, Seal Adhesion/Damage/Cracking (2310)

- Debris Impaction (2350)

- Adjacent Deck or Header/Metal Deterioration or Damage (2360)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.4.2 Pourable Joint Seal (Element 301)

A poured joint seal is made from compressible filler, backer rod, and a poured sealant. The compressible filler is set 1 to 2 inches from the top of the deck. In the space above the filler is a backer rod for a bond breaker and an asphalt or polymer-based pourable sealant.

The poured joint seal can accommodate movement of about 1/4 inch, so it is usually found at fixed joints or at expansion joints for very short-span structures.

Element Level Inspection

On the inspection report form, a pourable joint seal is recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of pourable joint seals should include the following items:

- Checking the joint for deterioration due to normal weathering, wear, and tear.
- Looking along the joint for loss of adhesion.
- Looking for cracks in the joint material.
- Examining the backwall and bearing seat for dampness or water stains that indicate loss of adhesion to the deck or backwall.
- Checking the adjacent deck for spalling which is causing loss of adhesion.
- Looking for debris that has impacted the joint material.
- Checking the vertical alignment across the joint. Impact on the bridge is increased when each side of the joint opening is at a different elevation.
- Noting any indiscriminate bituminous overlays that were placed over the joint.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Leakage, Seal Adhesion/Damage/Cracking (2310)
- Debris Impaction (2350)
- Adjacent Deck or Header/Metal Deterioration or Damage (2360)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

Figure 2.6.4.2-1 Poured Joint Seal – Condition State 3

2.6.4.3 Compression Joint Seal (Element 302)

A compression joint seal is a rectangular neoprene tube with an internal honeycomb cross-section. The seal is compressed as it is inserted (and sometimes glued) into a joint armored with steel angles. The honeycomb structure functions like a spring and allows the compression seal to expand against the sides of the joint as the joint moves.

Another type of compression seal is the cellular seal. The cellular seal is made of closed cell foam that allows the joint to move in different directions.

A large compression seal can accommodate expansion movements up to approximately 2 inches. However, they are most often used at fixed joints where limited movements are allowed. These types of joints tend to leak over time.

Element Level Inspection

On the inspection report form, a compression joint seal is recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of compression joint seals should include the following items:

- Checking the compression seal for deterioration due to normal weathering, wear, and tear.
- Looking along the joint for loss of adhesion or where the compression seal has pulled out or been driven down into the opening.
- Examining the backwall and bearing seat for dampness, water stains or debris accumulation that indicates a leak in the compression seal.
- Looking for debris that has impacted the compression seal.
- Checking for debris that has filled the joint, since these joint types are usually installed slightly recessed from the driving surface. Road debris may contain sharp objects that can puncture or rip the compression seal when run over by vehicle wheels.
- Removing debris from the joint to examine the seal for tears or punctures (if the removal can be safely done).
- Measuring the opening between steel anchorages or concrete headers. The temperature should be recorded as well.
- Checking the adjacent deck or backwall for spalls when steel angle armor is not used. When steel armor is used, check for spalls behind the steel armor, as well as debonding of the steel armor.
- Checking the vertical alignment across the joint. Impact on the bridge is increased when each side of the joint opening is at a different elevation.
- Noting any indiscriminate bituminous overlays that were placed over the joint. This prevents proper operation of the joint.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Leakage, Seal Adhesion/Damage/Cracking (2310)
- Debris Impaction (2350)
- Adjacent Deck or Header/Metal Deterioration or Damage (2360)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

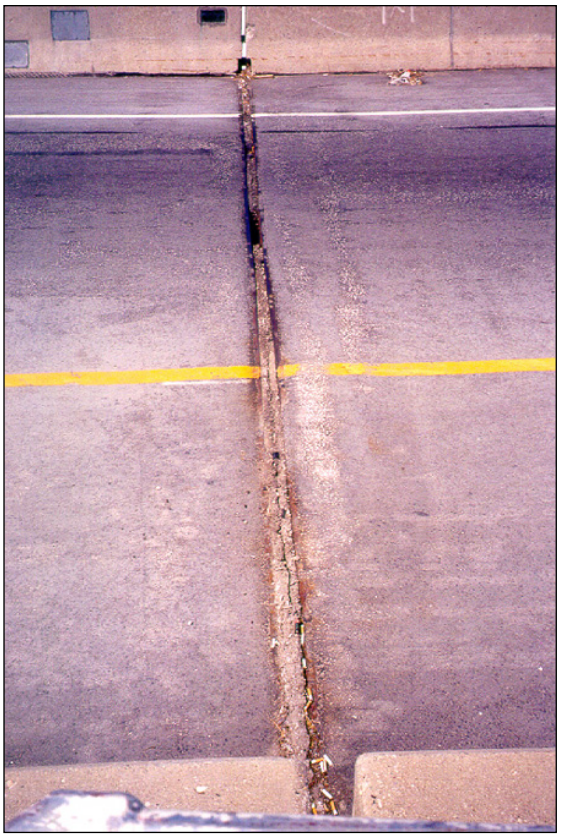

Figure 2.6.4.3-1: Compression Joint Seal Impacted with Debris and Pushed Down Into the Joint Opening (Far Lane)– Condition State 4.

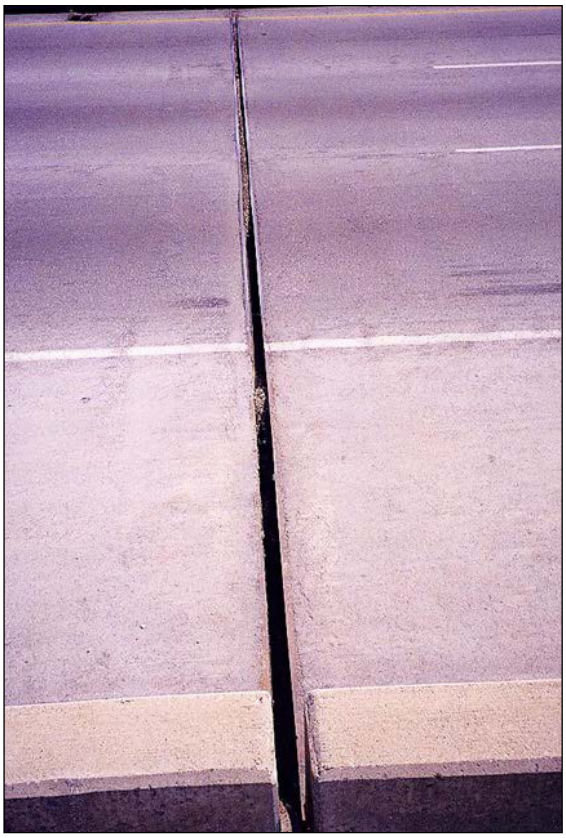

Figure 2.6.4.3-2: Compression Seal Pushed Down Into the Joint Opening - Condition State 3.

2.6.4.4 Modular Joint (Element 303)

A modular joint is a series of strip seals connected by intermediate steel separation beams. The steel member anchored to the deck or backwall is called the edge beam. The beams are supported by a stringer system to help carry traffic loads across these wider joints. They are mainly used on long span structures with large expansion lengths, having a normal range of movement between 4 and 24 inches. However, these joints can be fabricated to accommodate movements up to 48 inches.

Element Level Inspection

On the inspection report form, a modular joint is recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of modular joints should include the following items:

- Checking for debris that has filled the joint. Road debris may contain sharp objects that can puncture or rip the compression seal when run over by vehicle wheels. It can also prevent proper folding of the gland during superstructure expansion.
- Removing debris from the joint to examine the glands for tears or punctures (if the removal can be safely done).
- Looking for areas where the strip seal has pulled out of the extrusion.
- Listening for any rattles or indications of component looseness as traffic drives over the joint.
- Looking for any broken separation beams.
- Examining the backwall and bearing seat for dampness, water stains or debris accumulation that indicate a leak in one of the strip seals.
- Measuring the opening between the steel edge beams (the intermediate steel separation beams will therefore be included in this measurement). The temperature should be recorded as well.
- Checking the vertical alignment across the joint. Impact on the bridge is increased when each side of the joint opening is at a different elevation.
- Noting any indiscriminate bituminous overlays that were placed over the joint. This prevents proper joint operation.
- Looking for surface damage to seals and separation beams.

- Examining the underside for evidence of leakage and fractured welds or bolts. Check for free movement of all segments.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Leakage, Seal Adhesion/Damage/Cracking (2310)
- Debris Impaction (2350)
- Adjacent Deck or Header/Metal Deterioration or Damage (2360)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

Figure 2.6.4.4-1 Modular Expansion Joint – Condition State 1

2.6.4.5 Open Expansion Joint (Element 304)

Open expansion joints, sometimes called formed joints, are little more than a gap between the bridge deck and the abutment backwall or between adjacent deck sections. Open joints allow water and debris to pass directly through the joint and directly onto the girders and bearings below. Because this water and debris can quickly corrode steel and lock up expansion bearings, use of open expansion joints is highly discouraged in modern designs.

Open expansion joints are usually unprotected, but the deck slab and backwall can be armored with steel angles. Open joints are common on short span bridges with concrete decks.

Element Level Inspection

On the inspection report form, an open expansion joint is recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of open expansion joints should include the following items:

- Checking the corners of the deck and backwall for cracks and spalls.
- Examining the backwall and bearing seat for excessive corrosion and debris accumulation.
- Checking the adjacent deck for spalling or cracking which is causing loss of armor anchorage.
- Checking the vertical alignment across the joint. Impact on the bridge is increased when each side of the joint opening is at a different elevation.
- Measuring the opening. The temperature should be recorded as well.
- Noting any indiscriminate bituminous overlays that were placed over the joint. Overlay material wedged inside of the opening can prevent proper movement of the superstructure and introduce loads not intended for in the original design.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Leakage, Seal Adhesion/Damage/Cracking (2310)
- Debris Impaction (2350)
- Adjacent Deck or Header/Metal Deterioration or Damage (2360)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.4.6 Assembly Joint Without Seal (Element 305)

Some examples of these joints are Finger Plate joints and Sliding Plate joints. Finger plate joints, also known as a tooth plate joints, consist of two steel plates with overlapping fingers to provide for a smooth riding surface. These joints are usually found on longer span bridges where greater expansion is required. They may allow water and road debris to pass through the opening directly onto the superstructure below or a flexible trough is placed underneath of the opening to direct water and debris away, as with current design practice. The two types of finger plate joints are supported and cantilever.

The supported finger plate joint is used on longer spans. The fingers on this joint have their own support system in the form of transverse beams under the joint. Some types of finger plate joints are segmental, allowing for maintenance and replacement if necessary. Cantilever joints have no support beams.

Sliding plate joints are designed to allow one plate to slide over the top of another. This joint is usually not watertight so an elastomeric sheet is sometimes used to seal the joint. Pourable joint fillers are also sometimes used to seal the openings, but these are usually only effective in the short term. The sliding plate joint can accommodate a maximum movement of 4 inches.

Element Level Inspection

On the inspection report form, a finger or sliding plate joint is recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of finger plate, sliding plate, and other expansion joints should include the following items:

- Looking for broken teeth on finger joints.
- Looking for debris lodged between the plates of a sliding plate joint
- Checking the horizontal and vertical alignment of the joint elements. In a finger plate joint, the individual fingers should mesh together without interference and should match the same plane as the deck surface. Vertical misalignments cause additional impact forces on the joint and bridge.
- Measuring the joint opening. On finger plate joints, this measurement should be taken from a fingertip of one plate to the cut-out root of the opposing plate. On sliding plate joints, this measurement is taken from the tip of the top plate to the joint armor vertical face on the opposite side of the opening. The temperature should be recorded as well.

- Listening for any rattles or indications of component looseness as traffic drives over the joint.

- Checking the support condition from below the deck. Look for broken welds and corrosion.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Leakage, Seal Adhesion/Damage/Cracking (2310)

- Debris Impaction (2350)

- Adjacent Deck or Header/Metal Deterioration or Damage (2360)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green

- Condition State 2 Fair Yellow

- Condition State 3 Poor Orange

- Condition State 4 Severe Red

Figure 2.6.4.6-1: Sliding Plate Expansion Joint (Note Transverse Deck Crack on Left Side Suggesting a Failing Anchorage System) – Condition State 2.

Figure 2.6.4.6-2: Finger Plate Expansion Joint – Condition State 1.

2.6.4.7 Other Joint (Element 306)

Other joint will be a place holder for any type of joint that does not fit into one of the elements listed above.

Element Level Inspection

On the inspection report form, Other Joint is recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering

indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Leakage, Seal Adhesion/Damage/Cracking (2310)
- Debris Impaction (2350)
- Adjacent Deck or Header/Metal Deterioration or Damage (2360)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.5 Strengthening or Repair Systems

2.6.5.1 FRP (Element 8800)

This defines Fiber-Reinforced Polymer (FRP) wrapped columns and pier caps as well as FRP used for strengthening slabs and beams. FRP wraps are typically used to provide structural capacity to columns, beams, or slabs that have impact damage, corrosion, or other types of deterioration. FRP will consist of all strengthening repairs made to various structural members.

Each FRP wrap is evaluated individually. The underlying concrete of a FRP wrap is considered to be repaired prior to the proper installation of the wrap. The condition state of the underlying concrete is increased to a condition state 1 due to this repair prior to FRP installation. If an element is partially FRP wrapped, the FRP and concrete would be coded separately with the various associated units (SF, LF, EA). Patched concrete not covered by an FRP repair is coded as condition state 2.

Element Level Inspection

On the inspection report form, FRP wrap is recorded in units of "each". It is the inspector's task to examine each FRP wrap and reasonably assign the most severe defect Condition State to the entire element. This will quantify wraps' state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Deterioration (1220)
- Distortion (1900)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow

- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.5.2 Jacketing (Element 8801)

This defines jacketing an element with steel or concrete to add structural capacity to the element. This is frequently used in areas with seismic activity to strengthen columns and beams. Jacketing will consist of all jackets found on substructure units, regardless of material type. Examples include concrete jacket on timber column, steel jacket on concrete column, steel jacket on timber column, concrete jacket on a concrete column etc.

Each jacket is evaluated individually. The underlying material to which the jacket is applied is considered to be repaired prior to the proper installation of the jacket. The condition state of the underlying concrete is increased to a condition state 1 due to this repair prior to jacket installation. If an element is partially jacketed, the jacket and concrete would be coded separately with the various associated units (SF, LF, EA). However, if a timer pile is jacketed, the timber will typically not be repaired prior to jacket installation. In this case, the timber pile will remain in the previous condition state. The jacket will then be coded by the exposed surfaces. Patched concrete not covered by a jacket is coded as condition state 2.

Element Level Inspection

On the inspection report form, Jacketing is recorded in units of “each”. It is the inspector’s task to examine each Jacketing and reasonably assign the most severe defect Condition State to the entire element. This will quantify wraps’ state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity..

- Corrosion (1000)
- Cracking (Steel) (1010)
- Connection (1020)
- Delaminations/Spalls/Patch Areas (1080)
- Exposed Rebar (1090)
- Cracking (PSC) (1110)

- Cracking (RC) (1130)
- Abrasion/Wear (PSC/RC) (1190)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.5.3 Culvert Liner (Element 8802)

This defines elements that are inserted into culverts to add structural stability due to excessive erosion, deterioration, corrosion, or other defect to the original culvert material. This system is used to strengthen and stabilize a deteriorated culvert. If a culvert has a culvert liner, the original culvert will typically not be repaired prior to liner installation. In this case, the original culvert material will remain in the previous condition state noted prior to liner installation. The liner will then be evaluated by the exposed surfaces.

Element Level Inspection

On the inspection report form, culvert liners are recorded in units of lineal feet along the barrel of the culvert, typically perpendicular to the roadway. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Deterioration (1220)
- Distortion (1900)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.5.4 External Post Tensioning (Element 8803)

This element defines the system used to strengthen a beam, column, cap, or footing by means of external post tensioning. This is typically necessary when existing tendons are damaged, corroded, cut, broken, or have lost their tensioning force. External post tensioning will typically be attached to the existing structure and possibly encased in concrete for added protection. External Post Tensioning will consist of steel material. This element is not to be used with Steel Tension Rods/Post Tensioning Cables (Element 8165).

Element Level Inspection

On the inspection report form, External Post Tensioning is recorded in units of “each”. It is the inspector’s task to examine each repair and reasonably assign the most severe defect Condition State to the entire element. This will quantify the approach’s state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Corrosion (1000)
- Cracking (Steel) (1010)

- Connection (1020)
- Delaminations/Spalls/Patch Areas (1080)
- Exposed Rebar (1090)
- Cracking (PSC) (1110)
- Cracking (RC) (1130)
- Abrasion/Wear (PSC/RC) (1190)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.6 Protective Coatings

With increasing research, the uses of protective systems are increasing the life of bridge decks. Many bridge decks require repair before the components of the bridge structure. Protecting the bridge deck from contamination and deterioration is becoming more common practice in order to extend the life of a bridge.

2.6.6.1 Concrete Protective Coating (Element 521)

This element is a place holder and should not be used at this time. This element does not include any type of painting or other sealing on any other concrete surface. Painted concrete surfaces should be evaluated under Aesthetic Treatments (Assessment 9010).

Future uses for this element may include concrete elements that have a protective coating applied to them. These coatings 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.

Element Level Inspection

This element is a place holder and thus should not be on the inspection report form.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Effectiveness (3540)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.6.2 Steel Protective Coating - Other (Element 515)

This element is for all Steel Protective Coatings other than the ones described below in this section.

Protective coatings are to be evaluated separately from the primary material element, regardless of the condition of the element it protects. Steel Protective Coatings (Elements 515, 8516, 8517, 8518 and 8519) will be calculated for all steel superstructure elements, as well as primary steel substructure elements (pier caps, columns, towers, and abutments).

The presence of lead paint is possible and should be considered when performing inspections of steel protective coatings. Any feasible actions for protective coatings should also identify the presence lead paint.

Element Level Inspection

On the inspection report form, protective coatings are recorded in units of square feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

The sum of all of the reported condition states must equal the total quantity of all coated superstructure or substructure elements. All superstructure or substructure elements with a steel protective coating will be quantified and listed under the corresponding primary superstructure or substructure element. An example would be a four-girder bridge with a floor system would have the protective coating quantity for the girders, floor beams, stringers, gusset plates, bracing, etc. This quantity the total quantity for the all of the elements listed would then be combined and placed under the primary superstructure element (steel girder). Similarly, a steel bent with painted piles and painted cross bracing would have the total quantity for all elements/assessments placed under the primary substructure element (Steel Pile).

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Effectiveness (3440)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.6.3 Painted Steel (Element 8516)

Paint is a typical protective coating applied to steel after erection. Depending on the environment, paint can act as a barrier between the steel and corrosive elements for a significant amount of time before maintenance is required. If the paint is scratched or removed in any way the steel underneath will be exposed and can begin to corrode.

Protective coatings are to be evaluated separately from the primary material element, regardless of the condition of the element it protects. Steel Protective Coatings (Elements 515, 8516, 8517, 8518 and 8519) will be calculated for all steel superstructure elements, as well as primary steel substructure elements (pier caps, columns, towers, and abutments).

The presence of lead paint is possible and should be considered when performing inspections of steel protective coatings. Any feasible actions for protective coatings should also identify the presence lead paint.

Element Level Inspection

On the inspection report form, protective coatings are recorded in units of square feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

The sum of all of the reported condition states must equal the total quantity of all coated superstructure or substructure elements. All superstructure or substructure elements with a steel protective coating will be quantified and listed under the corresponding primary superstructure or substructure element. An example would be a four-girder bridge with a floor system would have the protective coating quantity for the girders, floor beams, stringers, gusset plates, bracing, etc. This quantity the total quantity for the all of the elements listed would then be combined and placed under the primary superstructure element (steel girder).

Similarly, a steel bent with painted piles and painted cross bracing would have the total quantity for all elements/assessments placed under the primary substructure element (Steel Pile).

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Effectiveness (3440)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.6.4 Weathering Steel (Element 8517)

Weathering steel was developed to eliminate the need for further protective coatings to be added after erection. The steel will develop a rust-like layer after being exposed to the atmosphere that will protect it from further corrosion. This rust-like layer is effectively acting as a protective coating and will be evaluated as such.

Weathering Steel is to be evaluated separately from the primary material element, regardless of the condition of the element it protects. Weathering Steel quantities shall be calculated for all steel superstructure elements comprised of weathering steel. Note that weathering steel blasted and painted does not constitute, two separate protective systems, nor a duplex system. In this case, the area painted would be evaluated under Painted Steel and the remaining portion of weathering steel with a protective patina would be evaluated under Weathering Steel.

Element Level Inspection

On the inspection report form, protective coatings are recorded in units of square feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

The sum of all of the reported condition states must equal the total quantity of all coated superstructure or substructure elements. All superstructure or substructure elements with a steel protective coating will be quantified and listed under the corresponding primary superstructure or substructure element. An example would be a four-girder bridge with a floor system would have the protective coating quantity for the girders, floor beams, stringers, gusset plates, bracing, etc. This quantity the total quantity for the all of the elements listed would then be combined and placed under the primary superstructure element (steel girder). Similarly, a steel bent with painted piles and painted cross bracing would have the total quantity for all elements/assessments placed under the primary substructure element (Steel Pile).

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Oxide Film Degradation Color/Texture Adherence – Weathering Steel (3430)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.6.5 Galvanization (Element 8518)

The process of applying a protective zinc coating to steel is referred to as galvanizing. This process will protect the steel from rusting through the ability of the zinc to act as a sacrificial anode rather than the steel. If the protective coating is scratched or removed the steel will still be protected from corrosion by the remaining zinc through self-repair, which a distinct advantage over paint and powder coating. The layer of zinc is effectively acting as a protective coating and will be coded as such.

Protective coatings are to be evaluated separately from the primary material element, regardless of the condition of the element it protects. Steel Protective Coatings (Elements 515, 8516, 8517, 8518 and 8519) will be calculated for all steel superstructure elements, as well as primary steel substructure elements (pier caps, columns, towers, and abutments).

Element Level Inspection

On the inspection report form, protective coatings are recorded in units of square feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

The sum of all of the reported condition states must equal the total quantity of all coated superstructure or substructure elements. All superstructure or substructure elements with a steel protective coating will be quantified and listed under the corresponding primary superstructure or substructure element. An example would be a four-girder bridge with a floor system would have the protective coating quantity for the girders, floor beams, stringers, gusset plates, bracing, etc. This quantity the total quantity for the all of the elements listed would then be combined and placed under the primary superstructure element (steel girder). Similarly, a steel bent with painted piles and painted cross bracing would have the total quantity for all elements/assessments placed under the primary substructure element (Steel Pile).

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects.

However, only the controlling defect will be counted in the total element condition state quantity.

- Effectiveness (3440)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.6.6 Duplex System (Element 8519)

A duplex protective system includes multiple systems protecting steel elements, specifically paint or power coating over hot-dip galvanized material. This is used to utilize maximum corrosion protection while remaining aesthetically pleasing. Combining the coatings delivers superior cathodic and barrier protection from the galvanizing and some barrier protection from the paint or powder. Once the paint or powder fails the galvanizing will still provide significant protection. The additional initial cost of both hot-dip galvanizing and painting or powder coating the steel will allow for added savings through minimal maintenance when compared to lesser protective coatings.

Protective coatings are to be evaluated separately from the primary material element, regardless of the condition of the element it protects. Steel Protective Coatings (Elements 515, 8516, 8517, 8518 and 8519) will be calculated for all steel superstructure elements, as well as primary steel substructure elements (pier caps, columns, towers, and abutments).

The presence of lead paint is possible and should be considered when performing inspections of steel protective coatings. Any feasible actions for protective coatings should also identify the presence lead paint.

Element Level Inspection

On the inspection report form, protective coatings are recorded in units of square feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify

the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

The sum of all of the reported condition states must equal the total quantity of all coated superstructure or substructure elements. All superstructure or substructure elements with a steel protective coating will be quantified and listed under the corresponding primary superstructure or substructure element. An example would be a four-girder bridge with a floor system would have the protective coating quantity for the girders, floor beams, stringers, gusset plates, bracing, etc. This quantity the total quantity for the all of the elements listed would then be combined and placed under the primary superstructure element (steel girder). Similarly, a steel bent with painted piles and painted cross bracing would have the total quantity for all elements/assessments placed under the primary substructure element (Steel Pile).

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the lowest numbered defect controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity.

- Effectiveness (3440)

When the paint system of a duplex protective system begins to show signs of failure, but the underlying galvanization remains intact and functional, the Condition State for defect Effectiveness shall be considered higher than 4. Only when the bare steel of the element becomes exposed should the protective system be considered completely compromised.

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.6.7 Concrete Reinforcing Steel Protective System (Element 520)

Conventional steel reinforcement corrosion causes detrimental effects on concrete decks. Epoxy coating is often used on all conventional steel deck reinforcement to prevent corrosion. The epoxy coating is resistant to chemicals, water, and atmospheric moisture. Epoxies utilize an epoxy polymer binder that forms a tough, resilient film upon drying and curing. Drying is by solvent evaporation, while curing entails a chemical reaction between the coating components.

Element 520 refers to visible cathodic protection systems only. Other coatings not visible (i.e. epoxy coated rebar) cannot be coded. Reinforcing protective system are denoted as part of the element used for decks and slabs. Select “set rebar” under the appropriately selected deck or slab element:

Black steel refers historically used uncoated bar steel reinforcement

Coated reinforcing steel is typically coated in epoxy in a factory to protect against corrosion.

Stainless steel has been utilized on high cost structures with very high traffic volumes. The corrosion process is negligible when stainless steel reinforcement is used. Solid stainless steel reinforcement bars can be used due to its corrosion resistance being greater than conventional reinforcement and an estimated service life of 100 years. Stainless steel coating / cladding can be used on conventional reinforcement to which will protect the reinforcement from water and air and quickly reform if the surface is scratched.

Non-metallic systems including Fiber-Reinforced Polymer (FRP), Glass Fiber Reinforced Plastic (GFRP), etc.

Reinforcing protective systems will have same area as the deck or slab. On initial inspections, existing plans should be verified to conclude reinforcing protective system used (e.g. epoxy coated).

2.6.7 Traffic Safety Features

Traffic safety features on a bridge include concrete barriers (parapets), railings, sidewalks, and curbs. Barriers (parapets) and railings prevent errant vehicular traffic from driving off the bridge or into opposing traffic. Sidewalks provide a safe path away from vehicular traffic for pedestrians and bicycles. Curbs, either as part of the sidewalk or base of a railing, provide a means to keep the wheels of vehicles (and therefore the vehicles themselves) from hitting pedestrians or the railing.

Bridge Railings

Bridge railings are constructed of concrete, steel, aluminum, timber or a combination of these. Railings built of solid concrete are often referred to as parapets. The primary functions of the bridge railing are to keep errant vehicles from driving off the bridge and to smoothly redirect these vehicles in such a manner that they do not overturn. Another function is to protect the main load-carrying elements of certain superstructure types (such as through trusses and arches) from damage due to vehicular impacts.

The bridge railing evaluation includes the curb. The curb will be evaluated using the material defects of which the curb is constructed, regardless if constructed of a different material from the bridge railing. The height of a barrier will determine if it is considered the railing or a curb.

- If the height of a bridge barrier is greater than or equal to 12”, then the barrier is considered a railing. Any additional railing topping the barrier should be coded under Decorative Rail (Assessment 9335) or Protective Screening (Assessment 9337).

- If the height of a bridge barrier is less than 12”, then the barrier is considered a curb and should be evaluated under the appropriate bridge railing located above the curb.

- The inspector should use engineering judgment to consider what the primary stopping force is when deciding if a barrier is a curb or railing.

When sidewalks are present on the bridge, railings are placed at the outermost edge of sidewalk. It is used to prevent pedestrians and bicycles from straying off the bridge and to give a minimum level of comfort while crossing. Sidewalks and medians are not to be coded under the bridge railings. These shall be coded under the appropriate assessment.

On the inspection report form, all railings are recorded in units of lineal feet. When wingwalls are not parallel to the roadway, railing quantities used for Element Level Inspections are measured from end of abutment to end of abutment. On bridges with wingwalls parallel to the roadway, railing quantities are measured from wing tip to wing tip, and these points will often coincide with the point of their beam guardrail attachment. When a combination of railings exist along one edge of the roadway (*e.g.,* metal stacked on concrete), the length is measured along the length of the roadway and should not be doubled for that one side.

The Condition States for rail elements are concerned with material deterioration severity. Damage that is not associated with material defects, such as traffic impact, needs to be recorded on the inspection form under the most appropriate defect. The inspector shall note the defect caused by traffic damage under the bridge railing element notes.

It is the inspector's task to examine the rails and reasonably assign the most severe Condition State to the entire element or portions thereof. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

When a bridge railing is comprised of several different material types, for example a thrie beam attached to the front face of a concrete parapet with a timber curb, and a unit of measure exhibits overlapping defects in all materials, the most severe defect Condition State will control. However, if the Condition States of the overlapping defects are the same, the defect of the bridge railing element shall be recorded above all other railing component defects, regardless if the other defect has a lower defect number. This is to ensure that the condition of the bridge railing element itself takes priority.

2.6.7.1 Metal Rail (Element 330)

Uncoated metal railings are constructed of aluminum or stainless steel, although uncoated steel rails are sometimes but rarely found. Uncoated metal rails rely on the material's inherent corrosion resistance to protect themselves from salt spray and atmospheric moisture. It is unusual to find an uncoated metal railing in Wisconsin.

On metal rails, the vertical members anchored to the deck are referred to as posts, while the horizontal members attached to the posts are referred to as rail beams.

Metal rails may have multiple different materials associated with it. In other words, the metal rail would be the primary rail; however, it may have a concrete curb, steel posts, and timber blocking between the posts and railing associated with it. Due to this fact, it may be necessary to code defects of other material types under Metal Rail. The inspector shall report the material defects on the primary rail material when coding overlapping defects of similar conditions states.

Figure 2.6.7.1-1 Metal Railing with Masonry Posts – Condition State 1

Element Level Inspection

On the inspection report form, bridge railings are recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of uncoated metal rails should include the following items:

- Examining the posts for section loss due to corrosion, spalling, or decay especially near its base. The largest bending moment of a post occurs at its base, which is unfortunately where most section loss will occur due to moisture and deicing chemicals.
- Looking for damage caused by vehicular collisions. Note the condition of the rail beam or post, as well as its remaining ability to withstand a second impact.
- Noting the extent of corrosion.
- Looking for solid anchorage of the post to the deck. Report any loose connections or anchorage losses.
- Examining the rail beam for loose connections to the posts.
- Checking the rail beam's horizontal and vertical alignment. Permanent deflections affect the railing's ability to properly redirect an errant vehicle.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the defect associated with the bridge railing material controls.

Metal railings may use multiple material defects for each rail. When deciding which type of material railing detailed in this chapter, the inspector is to consider the primary material of the railing. Other elements of the railing which may be made of other materials will be coded using each specific material defect, but quantified under the main railing material railing type. An example of this would be a metal railing with timber blocking. This railing can be coded using both material defects from steel and timber. The defects listed below are only to be used for the metal railing portion. The inspector is responsible to determine the necessary defects of the remaining components not constructed of metal.

- Corrosion (1000)
- Cracking (1010)

- Connection (1020)
- Distortion (1900)

Condition States

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.7.2 Reinforced Concrete Bridge Rail (Element 331)

Concrete railings (parapets) are very common on highway bridges. New Jersey-type concrete parapets have a proven track record for strength and serviceability. They are often able to absorb vehicle impacts without failing and are able to redirect, minimize rollovers, and not over-decelerate these vehicles during a crash.

Other concrete parapets have been recently developed for architectural effects. The most common is the Texas rail, which still satisfies current safety criteria while featuring decorative cutouts between the deck and top horizontal rail.

In order to use this element the entire rail must be made of concrete.

Concrete rails may have different materials associated with the curb. Due to this fact, it may be necessary to code defects of other material types under Reinforced Concrete Bridge Rail. The inspector shall report the material defects on the primary rail material when coding overlapping defects of similar conditions states.

Element Level Inspection

On the inspection report form, bridge railings are recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of concrete rails should include the following items:

- Looking for signs of impact damage, such as spalls, delamination and cracking. The location, severity, and size of the damage should be documented. Check the backside of the railing and deck edges for related cracking, delamination, and spalls.

- Checking the parapet for Delaminations, spalls, and exposed reinforcing steel. Large spalls can pose the additional hazard of snagging an errant vehicle.

- Inspecting the member for both vertical and transverse cracks.

- Checking the entire member for signs of corroding reinforcing steel, as indicated by rust stains or exposed reinforcement. Section loss associated with reinforcing steel corrosion can reduce the parapet's strength.

- Looking for leaching, and noting if it is stained with rust since this condition suggests reinforcing steel corrosion. These defects can grow into larger problems such as Delaminations and spalls.

- Checking previously repaired areas for soundness by hammer tapping.

- Looking for areas of scaling.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the defect associated with the bridge railing material controls. The defects listed below are only to be used for the reinforced concrete railing portion. The inspector is responsible to determine the necessary defects of the remaining components not constructed of reinforced concrete.

- Delaminations/Spalls/Patched Areas (1080)

- Exposed Rebar (1090)

- Cracking (RC) (1130)

- Abrasion/Wear (PSC/RC) (1190)

Condition States

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green

- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

Figure 2.6.7.2-1 Concrete Bridge Railing - Condition State 1

Figure 2.6.7.2-2 Concrete Bridge Rail – Most in Condition State 1 - Two Areas Condition State 3.

Figure 2.6.7.2-3 Scaling on the Lower Half of a Concrete Bridge Rail - Condition State 2

Figure 2.6.7.2-4 Ornamental Concrete Bridge Rail – Condition State 3

Figure 2.6.7.2-5 Concrete Bridge Railing - Condition State 4

Figure 2.6.7.2-6 Concrete Railing with Decorative Rail Assessment – Condition State 3

2.6.7.3 Timber Bridge Rail (Element 332)

Although timber is an acceptable material to the American Association of State Transportation and Highway Officials (AASHTO) for railing construction, timber rails are not commonly used for new designs unless aesthetics is important. Timber rails are more commonly found on older or rural bridges. Many older timber rails do not meet current safety or strength criteria. Timber rails are normally constructed using vertical posts anchored to the deck and horizontal rail beams connected to the posts.

Timber rails may have multiple different materials associated with it. In other words, the timber rail would be the primary rail; however, it may have a concrete curb, steel posts, and FRP blocking between the posts and railing associated with it. Due to this fact, it may be necessary to code defects of other material types under Timber Bridge Rail. The inspector shall report the material defects on the primary rail material when coding overlapping defects of similar conditions states.

Element Level Inspection

On the inspection report form, bridge railings are recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of timber rails should include the following items:

- Examining the posts and rail beams for splits, checks, and decay.
- Looking for damage caused by vehicular collisions, such as cracked, split or crushed rail beams, cracked posts, and post bases that have ripped away from the deck. Note the condition of the rail beam or post, as well as its remaining ability to withstand additional impact.
- Looking for solid anchorage of the post to the deck. Report any loose connections or anchorage losses.
- Examining the rail beam for loose connections to the posts.
- Checking the rail beam's horizontal and vertical alignment. Permanent deflections affect the railing's ability to properly redirect an errant vehicle.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the defect associated with the bridge railing material controls. Structural defects shall be coded in their entirety on the inspection report regardless if overlapping with material defects. However, only the controlling defect will be counted in the total element condition state quantity..

Timber railings may use multiple material defects for each rail. When deciding which type of material railing detailed in this chapter, the inspector is to consider the primary material of the railing. Other elements of the railing which may be made of other materials will be coded using each specific material defect, but quantified under the main railing material railing type. An example of this would be a timber railing with a concrete curb. This railing can be coded using both material defects from timber and concrete. The defects listed below are only to

be used for the timber railing portion. The inspector is responsible to determine the necessary defects of the remaining components not constructed of timber.

- Connection (1020)
- Decay/Section Loss (1140)
- Checks/Shakes/Cracks/Splits/Delaminations (1150)
- Abrasion/Wear (1180)
- Distortion (1900)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

Figure 2.6.7.3-1 Timber Bridge Railing - Condition State 1

Figure 2.6.7.3-2 Timber Bridge Railing – Condition State 2

Figure 2.6.7.3-3 Missing Timber Bridge Rail Beam – Condition State 3

2.6.7.4 Masonry Bridge Railing (Element 334)

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. Faux masonry elements (i.e. precast concrete blocks, reinforced concrete blocks, etc.) will not be rated under this set of elements. These types of material will be rated under “Other Materials”.

In order to use this element, the entire railing must be masonry.

Element Level Inspection

On the inspection report form, bridge railings are recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the defect associated with the bridge railing material controls. The defects listed below are only to be used for the masonry railing material. The inspector is responsible to determine the necessary defects of the remaining components not constructed of masonry.

- Mortar Breakdown (1610)
- Splits/Spall/Patched Area (1620)
- Masonry or Panel Displacement (1640)

Condition State Commentary

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

2.6.7.5 Other Material Bridge Railing (Element 333)

This element describes railings which are composed of other materials besides concrete, metal, timber, or masonry.

Element Level Inspection

On the inspection report form, bridge railings are recorded in units of lineal feet. Where multiple condition states exist within a unit of measure only the predominant defect in severity and extent is recorded. The other defects located within the unit of measure shall be captured by the inspector under the element or appropriate defect notes. The sum of all of the reported condition states must equal the total quantity of the element. This will quantify the element's state of deterioration and help generate quantity/cost estimates for future remedial work.

Maintenance inspection of combination rails should include the following items:

- Looking for signs of impact damage. On reinforced concrete components, evidence includes spalls and localized heavy cracking. The location, severity, and size of the damage should be documented. On metal components, evidence includes dents, bends, tears, and fractures. On timber components, evidence includes cracked, chipped or crushed rail beams, cracked posts, and post bases that have ripped away from the deck. Note the condition of the rail beam or post, as well as its remaining ability to withstand additional impact.

- Checking reinforced concrete components for Delaminations, spalls, and exposed reinforcing steel. Large spalls can pose the additional hazard of snagging an errant vehicle.

- On reinforced concrete components, reinforcing steel corrosion is indicated by rust stains or exposed reinforcement. Section loss associated with reinforcing steel corrosion can reduce the rail strength. On steel components, examine the posts for section loss due to corrosion, especially near their base. The largest bending moment of a post occurs at its base, which is unfortunately where most section loss due to moisture and deicing chemicals will occur. Note the paint/galvanized coating condition and extent of corrosion on coated steel. Check connection areas for dissimilar metal corrosion (aluminum rails with steel hardware).

- Examining the components for long-term deterioration. On timber components, check the posts and rail beams for splits, checks, and decay. On reinforced concrete components, look for both vertical and transverse cracks. Look also for leaching on concrete, and note if it is stained with rust since this condition suggests reinforcing steel corrosion. These defects can grow into larger problems such as Delaminations and spalls.

- Checking previously repaired areas for soundness and functionality.

- Checking horizontal and vertical alignment. Permanent deflections affect the railing's ability to properly redirect an errant vehicle.

- Looking for solid anchorage to the deck. Report any loose connections or anchorage losses.

- Examining rail beams for loose connections to the posts.

Element Defects

Refer to Appendix A for defect descriptions. The defects listed are unique to the element and element material (i.e. concrete, steel, timber, etc.). The order of the defect numbering indicates the controlling defect. Given multiple defects of the same condition state within a unit of measure, the defect associated with the bridge railing material controls. The defects listed below are only to be used for the other material railing portion. The inspector is responsible to determine the necessary defects of the remaining components not constructed of "other" material.

- Corrosion (1000)
- Cracking (1010)
- Connection (1020)
- Delamination/Spall/Patched Area (1080)
- Deterioration (1220)
- Distortion (1900)

Condition States

Appendix A defines the Condition States for each individual defect. The defects are expounded on and critical areas are discussed to aid the inspector in determining the severity of a defect. The WisDOT Field Manual tabulates the element defects listed above and bases the Condition States on the progression of severity for each defect. The Condition States are comprised of general descriptions and uniquely colored to follow the severity the description represents.

- Condition State 1 Good Green
- Condition State 2 Fair Yellow
- Condition State 3 Poor Orange
- Condition State 4 Severe Red

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