



## **BRIDGE INSPECTION MANUAL**

### **Preface**

The aim of the bridge inspection is to produce a report of the structure which gives a clear and accurate description of its condition at the time for comparison with earlier and subsequent inspection reports and to enable maintenance, repair and rehabilitation works to be prioritised and outlined.

### **1. BRIDGE INSPECTION PERSONNEL**

Personnel involved should have knowledge of bridge structure inspection and construction and be able to identify the regular maintenance requirement and structural deficiency.

### **2. SAFETY**

The safety of the bridge inspector is of the utmost importance. While the work may be hazardous, the accident probability may be limited by proceeding cautiously. Always be careful and use good judgment and prudence in conducting your activities both for your own safety and that of others.

For personal protection it is important to dress properly. Keep clothing and shoes free of grease. The following protective equipment is recommended for use at all times:

- Hard hat with a chin strap.
- Reflective vests or belts when working in traffic.
- Shoes with cork, rubber, or some other non-slip soles.

### **3. DOCUMENTATION OF THE BRIDGE INSPECTION**

The field inspection of a bridge should be conducted in a systematic and organized procedure that will be efficient and minimize the possibility of any bridge item being overlooked. Notes must be clear and detailed to the extent that they can be fully interpreted at a later date when a complete report is made. Sketches and photographs should be included in an effort to minimize long descriptions.

The explanatory aids are:

(1) Narrative descriptions. Descriptions of the condition should be as clear and concise as possible. Completeness, however, is essential. Therefore, narratives of moderate length will sometimes be required to adequately describe bridge conditions.

(2) Photographs. Photographs can be a great assistance. It is particularly recommended that pictures be taken of any problem areas that cannot be completely explained by a narrative description. It is better to take several photographs that maybe unessential than to omit one that would preclude misinterpretation or misunderstanding of the report. At least two photographs of every structure should be taken. One of these should depict the structure from the roadway while the other photo should be a view of the side elevation.

(3) Summary. An inspection is not complete until a narrative summary of the condition of the structure has been written.

### **4. RECORDING THE BRIDGE INSPECTION**



#### 4.1 Identification Data

##### Bridge Number

The bridge number identifies a particular bridge and shall be assigned by the Road Administration. If a unique number has not been assigned by the Road Administration, the number shall be assigned in sequence within project limits.

##### Bridge Name / Location

Record a narrative description of the bridge location. It is recommended that the location be keyed to a distinguishable feature, such as road junctions, topographical features, and townships.

##### Kilometre Point

The Linear Referencing System (LRS) km point is used to establish the location of the bridge on the Highway Network. It must be from the same km point system as reported in the Bridge Data Base / Bridge Passports.

##### Route

Record the name of the roadway that the bridge carries.

##### Direction

This field is only to distinguish between structures whose identifications and location chainage are the same, but whose attributes require the recording of more than one structure.

##### Inspected By

The inspector is to sign the inspection report and will also type or print their name directly under the signature.

##### Date

The date the current inspection was performed

Page \_\_\_\_\_ of \_\_\_\_\_

Fill in current and total number of pages included in this bridge inspection report

#### 4.2 General Description

##### Year of Construction

Record the year of construction of the structure. If the year built is unknown, provide a best estimate. Complete replacement of the superstructure with a majority of the substructure replaced will be considered a new bridge.

##### Design Load Class

Indicate the live load for which the structure was designed.

##### Total Bridge Length

Record the length of the bridge to the nearest tenth of a meter. This shall be the length of roadway supported on the bridge structure. The length should be measured back to back of back walls of abutments or from paving notch to paving notch.

##### Roadway Width

The distance between the inside faces of rails, curbs or parapets, in other words; the clear width of the travelled roadway. The information to be recorded is the most restrictive minimum distance between curbs or rails on the structure roadway. The data recorded for this item must



be compatible with other related route and bridge data. The measurement should be exclusive of flared areas for ramps.

### **Lanes On and Under the Bridge**

Record the number of lanes being carried by the bridge and being crossed over by the bridge. Include all lanes carrying highway traffic (i.e., cars, trucks, buses) which are striped or otherwise operated as a full width traffic lane for the entire length of the structure or under the structure by the owning/maintaining authority. This shall include any full width merge lanes and ramp lanes, and shall be independent of directionality of usage (i.e., a 1-lane bridge carrying 2-directional traffic is still considered to carry only one lane on the structure). Code N for these cases if there are no highway lanes on or under the bridge.

### **Curb or Sidewalk Widths**

Record the widths of the left and right curbs or sidewalks. "Left" and "Right" should be determined on the basis of direction of the inventory. Leave blank if no sidewalks or curbs are present.

### **Approach Roadway Width**

Record the normal width of usable roadway approaching the structure measured to the nearest tenth of a meter. Usable roadway width will include the width of traffic lanes and the widths of shoulders, where shoulders are defined as follows: Shoulders must be constructed and normally maintained flush with the adjacent traffic lane, and must be structurally adequate for all weather and traffic conditions consistent with the facility carried. Unstabilised grass or dirt, with no base course, flush with and beside the traffic lane is not to be considered a shoulder for this item.

### **Vertical Clearance**

Record the minimum vertical clearance between the roadway travel lanes or railroad rail underpass and the underside of a girder, beam, or flat slab. This measurement also refers to the minimum vertical clearance over waterways.

### **Type of Wearing Surface**

Provide information on the wearing surface type of the bridge deck.

### **Thickness of Surface Layer**

Record the thickness of surface (asphalt) layers.

### **Structure Type**

Record the predominant type of structure for the main span(s). Describe type of material and indicate the type of design construction, such as slab, tee beam, plate girder, continuous box girder, etc.

### **Number of Spans in Main Unit**

Record the number of spans in the main or major unit. This item will include all spans of most bridges, the major unit only of a sizable structure, or a unit of material or design different from that of the approach spans.

Note: Pedestrian bridges with ramps and staircases should show the ramps and staircases as approach spans.

### **Number of Approach Spans**

Record the number of spans in the approach spans to the major bridge, or the number of spans of material different from that of the major bridge



### **Slab**

Slab Type - Describe slab type, e.g. cast in situ, precast reinforced concrete, etc.

Slab Thickness - Record thickness of the slab

### **Longitudinal Beam**

Beam Type - Describe the longitudinal beam type, e.g. precast T-beam, simple pre-stressed concrete I-beam, etc.

No. of Beams - Record the number of longitudinal beams

Beam Dimensions - Record the dimension of the longitudinal beams

### **Cross Beam**

Beam Type - Describe the type of the cross beam, e.g. cast in situ concrete, precast concrete, etc.

Beam Dimensions - Record the dimension of the cross beam

### **Piles / Columns**

Pile Type - Describe the pile / column type, e.g. cast in situ concrete, precast, etc

No. of Piles - Record the number of piles

Pile Dimensions - Record the dimension of the piles

### **Abutment**

Abutment Dimensions - Record the dimensions of the abutment

Wing Wall Type - Describe the wing wall type

Wing Wall Length and Thickness - Record the dimension of wing walls

### **Bearings**

Location - Describe the location of bearings, such as 'east abutment' or 'pier 2'

Type - Record the type of bearings

### **Joints**

Location - Describe the location of the expansion joint, such as 'east abutment' or 'pier 2'

Type - Record the type of expansion joint

## **4.3 Structure Evaluation**

A bridge is typically divided into two main units, the substructure and the super-structure. These basic units are divided into structural members or components. The general procedure for evaluating a structure is to assign a numerical rating to the condition of each element or component of the main units.

The numerical rating system to be used is provided in the corresponding chapter below.

### **4.3.1 Definition of Condition Ratings**

Condition Ratings based on the field inspections can be considered as "snapshots in time" and cannot be used to predict future conditions or behaviour of the structure. However, the Condition Ratings based on the inspections along with the written comments by the field inspector act as the major source of information on the status of the bridge.

Condition Ratings are a measure of the deterioration or damage and are not a measure of design deficiency. For instance, an old bridge designed to lower load capacity but with little or no deterioration may have excellent Condition Ratings while a newer bridge designed to modern loads but with deterioration will have lower Condition Ratings.



### 4.3.2 Recording Condition Ratings

Condition Ratings are entered on the Bridge Inspection Record. There are following component items covered on the form.

- Superstructure
- Substructure
- Approaches
- Channel

### 4.3.3 Assigning Condition Ratings

The general considerations for assignment of the levels of Condition Ratings require that each element be evaluated separately. However, other deficiencies may affect the condition if they are directly related. For instance, instability of an approach embankment may reduce the Abutment Condition Rating but not reduce the Superstructure Condition Rating.

Only permanently installed repairs are to be considered when assigning Condition Ratings. Permanent implies that the repair has returned the damaged or deteriorated element to a condition as good as or better than the remainder of the bridge. For instance, a steel beam damaged by an overheight load that reduced the load capacity of the beam is considered permanently repaired when a section is replaced or a bent section is straightened by proper techniques and no residual cracks can be found. The strength of the repaired member is the primary concern. Modifications and repairs that simply improve the appearance of a damaged member should not be considered to improve the Condition Rating. Components with temporary repairs, even though functioning, should not be considered for Condition Rating. For instance, a support or brace to a partially undermined column could be susceptible to damage from another flood; therefore, the Condition Rating must be made on the basis that the support is not present.

Condition Ratings are still a matter of judgment, which should be made based on experience, knowledge, and consistency with other structures with the same deterioration.

### 4.3.4 Rating Definitions

The condition rating has been based on the AASHTO Manual for the Condition Evaluation of Bridges. If poor quality construction will result in accelerated deterioration or result in reduced strength of a member, this condition should be noted in the comments and considered in the rating of that item even though it was built that way.

The load-carrying capacity will not be used in evaluating condition items. The fact that a bridge was designed for less than current legal loads and may be posted will have no influence upon condition ratings.

#### **Rating**

Provide an overall characterization of the general condition of the entire component being rated in accordance with the rating definitions as described below.

#### **Total Quantity**

The numeric sum of an element's measurements

#### **Quantity in Condition States**

Record the portion of an elements total quantity fitting the description of the particular condition state.



## Comments

Notes used to further describe and clarify the element's condition.

### 4.3.4.1 Superstructure

#### Wearing Surface

This item is to rate the condition of the deck surface only. The inspector must note in the comment field on the Bridge Inspection Report if he / she is rating the structural deck surface or a protective wearing surface (ie, thin epoxy, wood, bituminous or, latex overlay). If there is no protective wearing surface, rate the condition of the surface of the structure deck. A concrete or bituminous wearing surface should be inspected for spalling, cracking, scaling, and delamination. Rate and code the condition in accordance with the following ratings.

#### Code Description

N NOT APPLICABLE: Code N for structures without decks, e.g., filled arch bridge.

9 NEW CONDITION: No noticeable or noteworthy deficiencies which affect the condition of the surface.

8 GOOD CONDITION: Minor cracking less than 0.8mm wide with no spalling, scaling or delamination.

7 GOOD CONDITION: Open cracks less than 1.6 mm wide at a spacing of 3 m or more, lights hallow scaling allowed.

6 FAIR CONDITION: Surface has considerable number of open cracks greater than 1.6 mm wide at a spacing of 1.5 or less. Surface area exhibits 2% or less of spalled or delaminated areas, including repaired areas. Medium scaling on the surface is 6.4 mm to 13 mm in depth.

5 FAIR CONDITION: Between 2% and 10% of the surface area is spalled or delaminated. There can be excessive cracking in the surface. Heavy scaling 13 mm to 26 mm in depth can be present. This includes repaired areas and/or areas in need of corrective action.

4 POOR CONDITION: Large areas of the surface, 10 - 25% is spalled or delaminated. This area includes repaired areas and/or areas in need of corrective action.

3 SERIOUS CONDITION: More than 25% of the surface area is spalled. This area includes repaired areas and/or areas in need of corrective action.

2 CRITICAL CONDITION: Emergency surface repairs required by the crews.

1 IMMINENT FAILURE CONDITION: Bridge is closed to traffic, but corrective action may put the bridge back in service.

0 FAILED CONDITION: Bridge closed.

#### Expansion Joints

Expansion joints provide for the expansion and contraction of the bridge superstructure. Examine carefully for proper opening, anchorage, and deterioration. Also check beam-to-back wall clearances.



The joints to be rated in this item include expansion joint devices such as strip seals, compression seals, assembly joint seals, polymer block out joints, steel armor joints, pourable seals, and compression seals.

Joints such as cold joints, construction joints and other joints that do not have a seal will be coded in item 'Other Joints'.

### **Code Description**

N NOT APPLICABLE: Code N for jointless bridges, and structures without decks, ie sand filled arches.

9 NEW CONDITION: No noticeable or noteworthy deficiencies which would affect the operation, movement, or water tightness of the joints.

8 GOOD CONDITION: Condition same as in 9 above with possible minor accumulation of non-compressibles and debris in the expansion opening.

7 GOOD CONDITION: Minor deterioration with shallow hairline cracks less than 0.8 mm within 0.5 m of the joint. No noticeable water leakage.

6 FAIR CONDITION: Minor deterioration with shallow hairline cracks greater than 0.8 mm and shallow spalls within 0.5 m of the joint. Device components maybe uneven, misaligned, or the joint opening is closed. No noticeable water leakage.

5 FAIR CONDITION: Moderate deterioration of surrounding concrete including cracking and shallow spalling. Minor leakage due to adhesion failures of the seal and/or anchorage device (less than 5% of the length).

4 POOR CONDITION: Major deterioration of surrounding concrete including cracking and spalling to steel. Leaking along more than 5% of the seal and/or anchorage device.

3 POOR CONDITION: Surrounding concrete is spalled below steel on top or bottom of deck with possible full-depth failures. Most of device is leaking or loose. Ride quality may be impacted.

2 CRITICAL CONDITION: Device and surrounding concrete is seriously deteriorated. Emergency repairs may be required for lane to remain open. Temporary joint support from underneath may be necessary.

1 IMMINENT FAILURE CONDITION: Lane closed to traffic, but corrective action may put the bridge back in service.

0 FAILED CONDITION: Bridge closed.

### **Other Joints**

This item includes typically unsealed joints such as cold joints, construction joints, and expansion joints off of the bridge (i.e. "jointless bridges") in the approach slab.

### **Code Description**

N NOT APPLICABLE: Code N for structures without decks, ie sand filled arches.



- 9 NEW CONDITION: No noticeable wear or leakage.
- 8 GOOD CONDITION: Condition same as in 9 above with possible minor accumulation of non-compressibles and debris in the tooled opening.
- 7 GOOD CONDITION: Minor deterioration with shallow hairline cracks less than 0.8 mm within 0.5 m of the joint. No noticeable water leakage.
- 6 FAIR CONDITION: Minor deterioration with shallow hairline cracks greater than 0.8 mm and shallow spalls within 0.5 m of the joint. No noticeable water leakage.
- 5 FAIR CONDITION: Moderate deterioration of surrounding concrete including cracking and shallow spalling. Minor leakage, along less than 5% of the length of the joint.
- 4 POOR CONDITION: Major deterioration of surrounding concrete including cracking and spalling to steel. Leaking along more than 5% of the length of the joint.
- 3 POOR CONDITION: Surrounding concrete is spalled below steel on top or bottom of deck with possible full-depth failures. Most of joint is leaking. Ride quality may be impacted.
- 2 CRITICAL CONDITION: Joint and surrounding concrete is seriously deteriorated. Emergency repairs may be required for lane to remain open. Temporary joint support from underneath may be necessary.
- 1 IMMINENT FAILURE CONDITION: Lane closed to traffic, but corrective action may put the bridge back in service.
- 0 FAILED CONDITION: Bridge closed.

## Railing

This item is for the evaluation and rating of vehicular railing and pedestrian fencing on the supported spans of the bridge. Report the type of railing in the comment section and report if the railing components meet the current standard.

Report collision damage in the comment section and on the work recommendation list.

### Code Description

- N NOT APPLICABLE: Code N for bridges that do not have railings such as buried bridges that have guardrail off the shoulders.
- 9 NEW CONDITION: No noticeable wear, deterioration or collision damage.
- 8 GOOD CONDITION: Small and superficial wear, deterioration, or collision damage.
- 7 GOOD CONDITION: Minor deterioration with shallow hairline cracks in concrete components less than 0.8 mm or shallow scaling. Failure of paint or galvanizing coated steel is very small and in scattered locations. Collision damage limited to minor scrapes.
- 6 FAIR CONDITION: Minor deterioration with shallow hairline cracks in concrete components greater than 0.8 mm and shallow spalls or scaling limited to less than 2 % of the surface area. Failure of the coating on steel components is limited to less than 2% of the surface area with no loss of section. Collision damage limited to minor scrapes.





- 5 FAIR CONDITION: Moderate deterioration with cracks in concrete components and spalls or scaling limited to less than 5 % of the surface area. Failure of the coating on steel components is limited to less than 5% of the surface area with minor loss of section. Collision damage limited to minor scrapes or temporary repairs in place.
- 4 POOR CONDITION: Major deterioration with cracks in concrete components and spalls or scaling greater than 5 % of the surface area. Failure of coating on steel components is greater than 5% of the surface area with some loss of section. Some collision damage but not affecting the performance of the railing. Temporary repairs may be in place.
- 3 POOR CONDITION: Most of the railing components exhibit deterioration and/or loss of section. Collision damage and deterioration has not progressed to the point where the railing will fail if impacted.
- 2 CRITICAL CONDITION: Most of the railing components exhibit deterioration and/or loss of section. Collision damage and deterioration has progressed to the point where the railing may fail if impacted. Immediate repairs are called for.
- 1 IMMINENT FAILURE CONDITION: Lane or shoulder closed to traffic and temporary concrete barricades or thrie beam in place to keep the bridge open. Corrective action may put the bridge back in service.
- 0 FAILED CONDITION: Bridge closed.

#### **Sidewalks or Curbs**

Curbs, sidewalks and walkways do not normally contribute to the structural strength of the bridge. They are provided mainly for motorist safety and pedestrian convenience and protection.

This item is for the evaluation and rating of the surface of sidewalks and curbs on the supported spans only. They should be examined for deterioration, security of connections and hazards to pedestrians. The areas below the sidewalk are to be rated with the deck. The inspector must note in the comment field if the sidewalk is on only one side of the bridge.

#### **Code Description**

- N NOT APPLICABLE: Code N for structures without sidewalks or curbs.
- 9 NEW CONDITION: No noticeable or noteworthy deficiencies which affect the condition of the surface.
- 8 GOOD CONDITION: Minor cracking less than wide 0.8 mm wide with no spalling, scaling, or delamination.
- 7 GOOD CONDITION: Open cracks less than 1.6 mm wide at a spacing of 3 m or more, light shallow scaling allowed.
- 6 FAIR CONDITION: Surface has considerable number of open cracks greater than 1.6 mm wide at a spacing of 1.5 m or less. Surface area exhibits 2% or less of spalled or delaminated areas, including repaired areas. Medium scaling on the surface is 6.4 mm to 13 mm in depth.



- 5 FAIR CONDITION: Between 2% and 10% of the surface area is spalled or delaminated. There can be excessive cracking in the surface. Heavy scaling 13 mm to 26 mm in depth can be present. This includes repaired areas and/or areas in need of corrective action.
- 4 POOR CONDITION: Large areas of the surface, 10 - 25% is spalled or delaminated. This includes repaired areas and/or areas in need of corrective action. Spalls and scaling are not deep enough to cause a trip hazard.
- 3 SERIOUS CONDITION: More than 25% of the surface area is spalled. This area includes repaired areas and/or areas in need of corrective action. Spalls and scaling are not deep enough to cause a trip hazard.
- 2 CRITICAL CONDITION: Emergency surface repairs required.
- 1 IMMINENT FAILURE CONDITION: Sidewalk is closed to pedestrians, but corrective action may put it back in service.
- 0 FAILED CONDITION: Bridge closed.

### Deck

The primary function of the bridge deck is to provide a smooth riding surface and to transmit the wheel loads to the supporting members. It also provides a support for curbs, walkways, railings, medians, expansion joints, and provides a surface to transmit drainage off the bridge. There are several deck types, but the majority will consist of reinforced concrete, filled or unfilled steel grid, or corrugated steel. This item is to evaluate and rate the overall condition of the deck.

Code N for structures without decks, such as a filled arch bridge. A concrete deck should be inspected for cracking, scaling, spalling, leaching, potholing, delamination, and full or partial depth failures. Steel grid decks should be inspected for broken welds, broken grids section loss, and growth of filled grids from corrosion.

The condition of the wearing surface / protective coating system (BIR item 'Surface'), joints, expansion devices, curbs, sidewalks, parapets, fascias, bridge railing, and scuppers shall not be considered in the deck evaluation. However, their condition will be noted on the form in their respective items. The inspector must note in the comment field on the Bridge Inspection Report the factors and quantities that influenced the judgement for the rating.

### Code Description

- N NOT APPLICABLE: Code N for bridges without decks, e.g., filled arch bridge.
- 9 NEW CONDITION: No noticeable or noteworthy deficiencies which affect the condition of the deck.
- 8 GOOD CONDITION: Minor cracking less than 0.8 mm wide with no spalling, scaling or delamination on the deck surface or underneath.
- 7 GOOD CONDITION: Open cracks less than 1.6 mm wide at a spacing of 3 m or more, light shallow scaling allowed on the deck surface or underneath. Deck will function as designed.
- 6 FAIR CONDITION: Deterioration on the surface or underneath, including repaired areas, is 2% or less of the total area. There may be a considerable number of open cracks



greater than 1.6 mm wide at a spacing of 1.5 m or less on the deck surface or underneath. Medium scaling on the surface is 6.4 mm to 13 mm in depth. Deck will function as designed.

5 FAIR CONDITION: Deterioration on the surface or underneath, including repaired areas, is between 2% and 10% of the surface area. There can be excessive cracking in the surface. Heavy scaling 13 mm to 26 mm in depth can be present. Deck will function as designed.

4 POOR CONDITION: Deterioration on the surface or underneath, including repaired areas, is between 10 -25%. Deck will function as designed.

3 SERIOUS CONDITION: Deterioration on the surface or underneath, including repaired areas, is more than 25% of the surface area. Structural and/or load analysis may be necessary to determine if the structure can continue to function without restricted loading.

2 CRITICAL CONDITION: Deterioration has progressed to the point where the deck will not support design loads and must be posted for reduced loads. Emergency surface repairs may be required by the crews.

1 IMMINENT FAILURE CONDITION: Bridge is closed to traffic, but corrective action may put the bridge back in service.

0 FAILED CONDITION: Bridge closed.

## Drainage

Effective drainage is essential for the proper maintenance of a bridge.

This item is for noting poor drainage characteristics on the bridge deck. There is no rating scale. The inspector can note in the comments if there is ponding of water on the surface or debris build up on the deck or in the drains that is preventing water from getting to the drains. Condition of metal drip strips will be considered in rating the drainage item. The deck drains and the area adjacent to the deck drains are to be considered in the evaluation of item 'Deck'

## Stringer

This item describes the physical condition of all structural members below the deck and above the pier cap, trusses (deck & through trusses) and, suspension cables and suspenders. All structural members should be inspected for visible signs of distress which may include cracking, deterioration, section loss, and malfunction and misalignment of bearings or pin and hanger assemblies. On bridges where the deck is integral with the superstructure, the superstructure condition rating may be affected by the deck condition. The resultant superstructure condition rating may be lower than the deck condition rating in the situation where the girders have deteriorated or been damaged. Fracture critical components should receive careful attention because failure could lead to collapse of a span or the bridge. The inspector must note in the comment field on the Bridge Inspection Report the factors and quantities that influenced the judgement for the rating.

## Code Description

N NOT APPLICABLE



- 9 NEW CONDITION: No deficiencies in any of the structural components that will affect the long term performance.
- 8 GOOD CONDITION: All protective coatings are sound and functioning but with minor weathering of the coating and/or dirt contamination on structural components.
- 7 GOOD CONDITION: Minor coating failures on structural components. All members retain full section properties and function as designed.
- 6 FAIR CONDITION: Minor deterioration affecting non-structural members. Some protective coating shows failures. All members retain full section properties and function as designed.
- 5 FAIR CONDITION: Moderate deterioration affecting structural members. Minor section shows loss in low or no stress areas.
- 4 POOR CONDITION: Considerable deterioration affecting structural members with section loss up to 10 % in scattered and isolated areas. All members continue to function as designed.
- 3 SERIOUS CONDITION: Considerable deterioration affecting structural members with section loss up to 25% in scattered and isolated areas. Structural and/or load analysis may be necessary to determine if the structure can continue to function without restricted loading.
- 2 CRITICAL CONDITION: Deterioration has progressed to the point where the structure will not support design loads and must be posted for reduced loads.
- 1 IMMINENT FAILURE CONDITION: Bridge is closed to traffic, but corrective action may put the bridge back in service.
- 0 FAILED CONDITION: Bridge closed.

#### **Paint (for steel superstructures only)**

This item is to evaluate and rate the condition of the paint only. The inspector must note in the comment field on the Bridge Inspection Report the type of paint or coating system (such as weathering steel or galvanized beams) and the year that the paint was applied. The condition of the coating system may have influence on the rating of item Stringer also.

#### **Code Description**

- N NOT APPLICABLE: Code N for concrete superstructures, Weathering Steel superstructures, and galvanized beams.
- 9 NEW CONDITION: No deficiencies in the coating which will affect its long term performance.
- 8 GOOD CONDITION: Minor weathering of the coating and/or dirt contamination.
- 7 GOOD CONDITION: Minor pinhead size failures of the coating in scattered locations or on sharp edges.



- 6 FAIR CONDITION: Minor coating failures in scattered locations with a total area of less than 1%.
- 5 FAIR CONDITION: Moderate coating failures between 1% and 5% of the surface area. If areas of paint failure are concentrated under open joints, consideration may be given to zone painting.
- 4 POOR CONDITION: Large of areas coating failures, between 5% and 15% of the total surface. If areas of paint failure are concentrated under open joints, consideration may be given to zone painting. Otherwise, schedule for complete repainting when coating failure has progressed beyond 15%.
- 3 SERIOUS CONDITION: More than 15% of the coating has failed. Structure should be scheduled for complete repaint.
- 2 CRITICAL CONDITION: More than 50% of the coating has failed. Structure should be scheduled for complete repaint.
- 1 IMMINENT FAILURE CONDITION: Bridge is closed to traffic, but corrective action may put the bridge back in service.
- 0 FAILED CONDITION: Bridge closed.

### **Bearings**

This item describes the physical condition of bearings. Evaluate and rate the condition in accordance with the general condition ratings.

Code N for delta frame designs and bridges designed with the superstructure integral with the substructure. The inspector must note in the comment field on the Bridge Inspection Report the type of bearings on the bridge and the factors and quantities that influenced the judgement for the rating.

### **Code Description**

- N NOT APPLICABLE: Code N for frame designs and bridges designed with the superstructure integral with the substructure.
- 9 NEW CONDITION: No deficiencies in any bearing components that will affect the long term performance.
- 8 GOOD CONDITION: All protective coatings are sound and functioning but with minor weathering of the coating and/or dirt contamination on bearing components.
- 7 GOOD CONDITION: Minor coating failures in scatted locations on steel bearing components. All bearing components function as designed.
- 6 FAIR CONDITION: Minor deterioration affecting non-structural components. Some protective coating failures. Minor misalignment or loss of bearing support. All bearing components function as designed.
- 5 FAIR CONDITION: Moderate deterioration affecting bearing components. Minor misalignment, section loss or, loss of bearing in low or no stress areas.



- 4 POOR CONDITION: Considerable deterioration affecting bearing components with section loss up to 10 % in scattered and isolated areas, misalignment, and/or loss of bearing. All members continue to function as designed.
- 3 SERIOUS CONDITION: Considerable deterioration affecting bearing components with section loss up to 25 % in scattered and isolated areas. Structural and/or load analysis may be necessary to determine if the structure can continue to function without restricted loading.
- 2 CRITICAL CONDITION: Deterioration has progressed to the point where the structure will not support design loads and must be posted for reduced loads.
- 1 IMMINENT FAILURE CONDITION: Bridge is closed to traffic, but corrective action may put the bridge back in service.
- 0 FAILED CONDITION: Bridge closed.

#### 4.3.4.2 Substructure

The substructure is that portion of the bridge below the pier and abutment seats, including footers and piling. The substructure transmits the loads and stresses from the deck, superstructure, or other load supporting system, to the ground. All exposed or readily accessible portions of the substructure will be inspected at close range.

#### Abutments

An abutment is supporting the ends of a single span or the extreme ends of a multi-span superstructure and, in general, retaining or supporting the approach embankment. Examine abutments for condition, movement, bulging, cracking, settlement, joint integrity, leakage, and scour.

This item describes the physical condition of abutments, piles, fenders, footings or other substructure components in proximity of the abutments and below the bearings. The substructure rating is independent of the deck and superstructure.

All structural members should be inspected for visible signs of distress which may include cracking, deterioration, section loss, settlement, misalignment, scour, collision damage and corrosion. Integral - abutment wing walls to the first construction or expansion joint shall be included in the evaluation. For non-integral superstructure and substructure units, the substructure shall be considered as the portion below the bearings. For structures where the substructure and superstructure are integral, the substructure shall be considered as the portion below the superstructure. The inspector must note in the comment field on the Bridge Inspection Report the factors and quantities that influenced the judgement for the rating.

#### Code Description

N NOT APPLICABLE

9 NEW CONDITION: No deficiencies in any of the structural components that will affect the long term performance.

8 GOOD CONDITION: All structural components are sound and functioning as designed. There may be superficial cracking or weathering of protective coatings and/or dirt contamination on structural components.



- 7 **GOOD CONDITION:** All members retain full section properties and function as designed. There may be minor cracking in structural components.
- 6 **FAIR CONDITION:** All members retain full section properties and function as designed. There may be some deterioration affecting structural members such as minor cracking, scaling, small scattered spalls, or shallow scour. Some protective coating shows failures.
- 5 **FAIR CONDITION:** Moderate deterioration affecting structural members such as cracking, scalings, cattered spalls, minor settlement or shallow scour. Minor section shows loss in low or no stress areas. All members continue to function as designed.
- 4 **POOR CONDITION:** Considerable deterioration affecting structural members such as cracking, scaling, scattered spalls, partial settlement or, scour. All members continue to function as designed.
- 3 **SERIOUS CONDITION:** Considerable deterioration affecting structural members. Structural, hydraulic, and/or load analysis may be necessary to determine if the structure can continue to function without restricted loading or immediate repairs.
- 2 **CRITICAL CONDITION:** Deterioration has progressed to the point where the structure will not support design loads and must be posted for reduced loads.
- 1 **IMMINENT FAILURE CONDITION:** Bridge is closed to traffic, but corrective action may put the bridge back in service.
- 0 **FAILED CONDITION:** Bridge closed.

## Piers

A pier is a substructure supporting the ends of the spans of a multi-span superstructure at intermediate locations between the abutments.

This item describes the physical condition of piers, pier caps, crash walls, footings or other substructure components in proximity of the piers and below the bearings. The final rating for will be the lower of this rating and the rating for Abutments.

The substructure rating is independent of the deck and superstructure. All structural members should be inspected for visible signs of distress which may include cracking, deterioration, section loss, settlement, misalignment, scour, collision damage and corrosion. For structures where the substructure and superstructure are integral, the substructure shall be considered as the portion below the superstructure. The inspector must note in the comment field on the Bridge Inspection Report the factors and quantities that influenced the judgement for the rating. The location, size and, depth of any scour must be noted in the comments.

## Code Description

N NOT APPLICABLE

9 **NEW CONDITION:** No deficiencies in any of the structural components that will affect the long term performance.



- 8 GOOD CONDITION: All structural components are sound and functioning as designed. There may be superficial cracking or weathering of protective coatings and/or dirt contamination on structural components.
- 7 GOOD CONDITION: All members retain full section properties and function as designed. There may be minor cracking in structural components.
- 6 FAIR CONDITION: All members retain full section properties and function as designed. There may be some deterioration affecting structural members such as minor cracking, scaling, small scattered spalls, or shallow scour. Some protective coating failures.
- 5 FAIR CONDITION: Moderate deterioration affecting structural members such as cracking, scaling, scattered spalls, minor settlement or shallow scour. Minor section loss in low or no stress areas. All members continue to function as designed.
- 4 POOR CONDITION: Considerable deterioration affecting structural members such as cracking, scaling, scattered spalls, partial settlement or, scour. All members continue to function as designed.
- 3 SERIOUS CONDITION: Considerable deterioration affecting structural members. Structural, hydraulic, and/or load analysis may be necessary to determine if the structure can continue to function without restricted loading or immediate repairs.
- 2 CRITICAL CONDITION: Deterioration has progressed to the point where the structure will not support design loads and must be posted for reduced loads.
- 1 IMMINENT FAILURE CONDITION: Bridge is closed to traffic, but corrective action may put the bridge back in service.
- 0 FAILED CONDITION: Bridge closed.

### **Slope Protection**

This item describes the physical condition of the slope protection ahead of and on the sides of the abutments. This rating could have impact on the evaluation and the rating assigned to the item 'Abutments'. The substructure rating is independent of the deck and superstructure.

The slope protection should be inspected for visible signs of distress which may include cracking, deterioration, settlement, misalignment, and scour. Report the location, size and, depth of any scour at the toe of the slope in the comments. The inspector must note in the comment field on the Bridge Inspection Report the factors and quantities that influenced the judgement for the rating.

### **Code Description**

N NOT APPLICABLE

9 NEW CONDITION: No deficiencies in any of the primary components that will affect the long term performance.

8 GOOD CONDITION: All primary components are sound and functioning as designed. There may be superficial cracking and/or dirt contamination on primary components.





- 7 GOOD CONDITION: All members retain full section properties and function as designed. There may be minor deterioration and/or cracking of primary components.
- 6 FAIR CONDITION: All members retain full section properties and function as designed. There may be some deterioration affecting primary members such as minor cracking, shallow settlement, scaling, small scattered spalls, or shallow scour.
- 5 FAIR CONDITION: Moderate deterioration affecting primary members such as cracking, scaling, scattered spalls, minor settlement or shallow scour. All members continue to function as designed.
- 4 POOR CONDITION: Considerable deterioration affecting primary members such as cracking, scaling, scattered spalls, partial settlement or, scour. All members continue to function as designed.
- 3 SERIOUS CONDITION: Considerable deterioration affecting primary members. Structural or hydraulic analysis may be necessary to determine if the structure can continue to function without restricted loading or immediate repairs.
- 2 CRITICAL CONDITION: Deterioration has progressed to the point where the structure will not support design loads and must be posted for reduced loads.
- 1 IMMINENT FAILURE CONDITION: Bridge is closed to traffic, but corrective action may put the bridge back in service.
- 0 FAILED CONDITION: Bridge closed.

#### 4.3.4.3 Approaches

A smooth transition between the roadway pavement and the bridge deck is important for the reduction of impact forces acting upon the bridge and for driving safety. A difference in elevation between the bridge deck and the approach pavement increases impact and vibration as the vehicle reaches the bridge. Rough approaches will also cause vibration in the vehicle, which in turn, transmits added vibration to the bridge.

#### Approach Slabs

Note and rate the condition, settlement or other signs of failure of the approach slab.

Code Description

- N Not applicable: Code N for bridges without approach slabs.
- 1 Approach slabs in excellent conditions, no repairs necessary.
- 2 Slabs may be cracked, minor spalls, but not settled.
- 3 Some settlement of the approach slab ends (no more than 5 cm); still flush with top of backwall.
- 4 Major settlement of approach slab ends (more than 5 cm) or pulled away from backwall and dropped down more than 3 cm.

#### Approach Pavement



This item is to evaluate and rate the overall condition of the road approach pavement. It includes the roadway area from the bridge seat at the abutments to 15 m away from the bridge or to the first joint. Rate and code the condition in accordance with the general condition ratings. Code N for structures without decks, such as a filled arch bridge where the pavement is carried across the structure on grade. The concrete or asphalt pavement should be inspected and evaluated for settlement, cracking, scaling, spalling, potholing, and delamination. The approach should allow for a smooth transition to the bridge deck. The inspector must note in the comment field on the Bridge Inspection Report the factors and quantities that influenced the judgement for the rating.

### **Code Description**

- N NOT APPLICABLE: Code N for bridges without decks, e.g., filled arch bridge.
- 9 NEW CONDITION: No noticeable or noteworthy deficiencies which affect the condition of the approach pavement.
- 8 GOOD CONDITION: Minor cracking less than 0.8 mm wide with no spalling, scaling or delamination on the approach pavement.
- 7 GOOD CONDITION: Open cracks less than 1.6 mm wide at a spacing of 3 m or more, light shallow scaling allowed in the surface. Approach pavement will function as designed.
- 6 FAIR CONDITION: Deterioration of the approach pavement, including repaired areas, is 2% or less of the total area. There may be a considerable number of open cracks greater than 1.6 mm wide at a spacing of 1.5 m or less in the approach pavement. Medium scaling on the surface is 6.4 mm to 13 mm in depth. Settlement is minor. Approach pavement will function as designed.
- 5 FAIR CONDITION: Deterioration of the approach pavement, including repaired areas, is between 2% and 10% of the surface area. There can be excessive cracking in the surface. Heavy scaling 13 mm to 26 mm in depth can be present. Settlement is less than 2 cm at the bridge seat. Approach pavement will function as designed.
- 4 POOR CONDITION: Deterioration on the approach pavement, including repaired areas, is between 10 -25%. Settlement is more than 2 cm at the bridge seat. Approach pavement will function as designed.
- 3 SERIOUS CONDITION: Deterioration in the approach pavement, including repaired areas, is more than 25% of the surface area. Urgent surface repairs may be required by the crews.
- 2 CRITICAL CONDITION: Deterioration has progressed to the point where the approach pavement will not function as designed. Emergency surface repairs may be required by the crews.
- 1 IMMINENT FAILURE CONDITION: Bridge is closed to traffic, but corrective action may put the bridge back in service.
- 0 FAILED CONDITION: Bridge closed.

### **Approach Shoulders and Sidewalks**



This item is to evaluate and rate the overall condition of the approach shoulders, sidewalks, and curbs and gutter. It includes those shoulders etcetera that are carried across the structure on grade. The concrete or asphalt pavement should be inspected and evaluated for settlement, cracking, scaling, spalling, potholing, and delamination. Gravel shoulders should have adequate slope and drainage. The inspector must note in the comment field on the Bridge Inspection Report the factors and quantities that influenced the judgement for the rating.

#### **Code Description**

- N NOT APPLICABLE: Code N if the bridge has no approach shoulders or sidewalks.
- 9 NEW CONDITION: No noticeable or noteworthy deficiencies which affect the condition of the approach shoulders or sidewalks.
- 8 GOOD CONDITION: Small and superficial deterioration or wear on the approach shoulders or sidewalks.
- 7 GOOD CONDITION: Minor deterioration or wear on the approach shoulders or sidewalks. All components will function as designed.
- 6 FAIR CONDITION: Some deterioration or wear on the approach shoulders or sidewalks. Settlement is minor. All components will function as designed.
- 5 FAIR CONDITION: Moderate deterioration or wear on the approach shoulders or sidewalks. Settlement is less than 2 cm at the bridge seat. All components will function as designed.
- 4 POOR CONDITION: Considerable deterioration or wear on the approach shoulders or sidewalks. Settlement is more than 2 cm at the bridge seat. All components will function as designed.
- 3 SERIOUS CONDITION: Serious deterioration or wear on the approach shoulders or sidewalks. Urgent surface repairs may be required by the crews.
- 2 CRITICAL CONDITION: Deterioration has progressed to the point where the approach shoulders and sidewalks will not function as designed. Emergency repairs may be required by the crews.
- 1 IMMINENT FAILURE CONDITION: Shoulder or sidewalks are closed to traffic, but corrective action may put the bridge back in service.
- 0 FAILED CONDITION: Bridge closed.

#### **4.3.4.4 Channel**

##### **Waterway Adequacy**

Scour and stream bed degradation are actually the result of inadequate waterway areas. The geometry of the channel, the amount of debris carried during high water periods, and the adequacy of freeboard should be considered in determining waterway adequacy. Where large quantities of debris and ice are expected, sufficient freeboard is of the greatest importance. Check for scour of stream beds and banks, sandbars or debris which could change the direction of flow, or other obstructions which could influence the adequacy of the waterway. Accumulation



of drift and debris on the superstructure and substructure should be noted on the inspection form and included in the condition rating.

#### **Code Description**

- N Not Applicable: Code N when the bridge is not over a waterway (channel).
- 1 No restriction of flow thru the channel.
- 2 Silt and Gravel build up restricts half of the channel; Tree or bush growing in the channel; Cattle fence attached to bridge; Rock dam under bridge.
- 3 Occasional over topping of bridge deck and roadway approaches with significant traffic delays; Debris caught in cross frames.
- 4 Frequent overtopping of bridge deck and roadway approaches with significant traffic delays.

#### **Protection**

This item describes the physical conditions associated with the flow of water through a bridge such as stream stability and the condition of the channel, riprap, slope protection or stream control devices including spur dikes. The inspector should be particularly concerned with visible signs of excessive water velocity which may affect undermining of slope protection, erosion of banks, and realignment of the stream which may result in immediate or potential problems. Accumulation of drift and debris on the superstructure and substructure should be noted on the inspection form but not included in the condition rating. Rate and code the condition in accordance with general condition ratings and following the descriptive codes:

#### **Code Description**

- N NOT APPLICABLE: Code N when the bridge is not over a waterway (channel).
- 9 NEW CONDITION: No noticeable or noteworthy deficiencies affect the condition of the channel.
- 8 GOOD CONDITION: Banks are protected or well vegetated. River control devices such as spur dikes and embankment protection are not required or are in a stable condition.
- 7 GOOD CONDITION: Bank protection is in need of minor repairs. River control devices and embankment protection have a little minor damage. Banks and/or channel, have minor amounts of drift.
- 6 FAIR CONDITION: Bank is beginning to slump. River control devices and embankment protection have widespread minor damage. Minor stream bed movement is evident. Debris is restricting the channel slightly.
- 5 FAIR CONDITION: Bank protection is being eroded. River control devices and/or embankment have major damage. Trees and brush restrict the channel.
- 4 POOR CONDITION: Bank and embankment protection is severely undermined. River control devices have severe damage. Large deposits of debris are in the channel.



3 SERIOUS CONDITION: Bank protection has failed. River control devices have been destroyed. Streambed, aggradations, degradation or lateral movement has changed the channel to threaten the bridge and/or approach roadway now.

2 CRITICAL CONDITION: The channel has changed to the extent the bridge is near a state of collapse.

1 IMMINENT FAILURE CONDITION: Bridge closed because of channel failure. Corrective action may put back in service.

0 FAILED CONDITION: Bridge closed because of channel failure. Replacement is necessary.

#### 4.4 Concrete Strength

##### Rebound Tester (Schmidt Hammer)

Concrete testing with the Schmidt test hammer is the most frequent used method for non-destructive concrete testing worldwide.

The Schmidt hammer measures the rebound of a spring loaded mass impacting against the surface of the sample. When conducting the test the hammer should be held at right angles to the surface which in turn should be flat and smooth. The rebound reading will be affected by the orientation of the hammer, when used in a vertical position (on the underside of a suspended slab for example) gravity will increase the rebound distance of the mass and vice versa for a test conducted on a floor slab.

The test is also sensitive to local variation in the sample. To minimise this it is recommended to take a selection of readings and take an average value.

Prior to testing, the Schmidt hammer should be calibrated using a calibration test anvil supplied by the manufacturer for that purpose. The average of 10 readings should be obtained.

##### Measuring Procedure

- Smoothen test area with a grinding stone
- Perform rest series of at least 10 test impacts
- Record rebound value R
- Read compressive strength from a conversion diagram

#### 4.5 Special Remarks, Sketches, Proposals for Rehabilitation, Recommendations

Notes used to further describe and clarify an element's condition and location. All notes should be preceded by the element to which they apply.

##### Condition Pictures and / or Sketches

An area is assigned to attach inspection photos or to sketch figures that will clarify to the reader element conditions or damage/deterioration locations on a bridge.



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## **ANNEX**

### **BRIDGE INSPECTION FORMS**



## Bridge Inspection Report

### Identification Data

Bridge No.: \_\_\_\_\_ Bridge Name / Location:

\_\_\_\_\_

Kilometre Point: \_\_\_\_\_ Route: \_\_\_\_\_ Direction:

\_\_\_\_\_

Inspected by: \_\_\_\_\_ Date:

\_\_\_\_\_

### A. General Description

ITEMS		DESCRIPTION/COMMENTS		
General and Dimensional Data	Year of Construction			
	Design Load Class			
	Total Bridge Length (m)			
	Roadway Width (m)			
	Number of Lanes On and Under the Bridge		Lanes on:	Lanes under:
	Curb or Sidewalk Width (m)		Left:	Right
	Approach Roadway Width (m)			
	Vertical Clearance (m)			
	Type of Wearing Surface			
	Thickness of Surface Layer (mm)			
	Structure Type			
	No of Spans in Main Unit			
	No. of Approach Spans			
Structural System	Slab	Slab Type		
		Slab Thickness (mm)		
	Longitudinal Beams	Beam Type		
		No. of Beams		
		Beam Dimensions (mm)		
	Cross Beam	Beam Type		
		Beam Dimensions (mm)		
	Piles / Columns	Pile Type		
		No of Piles		
Pile Dimensions (mm)				





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	Abutment	Abutment Dimensions (mm)		
		Wingwall Type		
		Wingwall Length & Thickness (m)		
	Bearings	Location		
		Type		
	Joints	Location		
		Type		



Bridge No.: \_\_\_\_\_ Bridge  
Name: \_\_\_\_\_

#### B. Detailed Assessment of Damages

##### Superstructure

Item Description	Rating	Quantity in Condition State	Total Quantity	Comments
Wearing Surface				
Expansion Joints				
Joints, Other				
Railing				
Sidewalks or Curbs				
Deck				
Drainage				
Stringer				
Paint (only steel superstructures)				



Bearings				



Bridge No.: \_\_\_\_\_ Bridge  
Name: \_\_\_\_\_

#### Substructure

Item Description	Rating	Quantity in Condition State	Total Quantity	Comments
Abutments				
Piers				
Slope Protection				

#### Approaches

Item Description	Rating	Quantity in Condition State	Total Quantity	Comments
Approach Slabs				
Approach Pavement				
Approach Shoulder and Sidewalks				

#### Channel

Item Description	Rating	Quantity in Condition State	Total Quantity	Comments
Waterway Adequacy				



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Protection				
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Bridge No.: \_\_\_\_\_ Bridge  
Name: \_\_\_\_\_

D. Measurement Data of the Rebound Tester (Schmidt Hammer)

Type of structural member:  **Superstructure**  **Cross Beam**  **Pile**

Single values ( R ):

Mean value	

Mean value	

Position of Rebound Tester

- Horizontal  
 Vertical  
 Inclined

Concrete Strength (N/mm<sup>2</sup>)  
(Cylinder compression strength)

--	--

Type of structural member:  **Superstructure**  **Cross Beam**  **Pile**

Single values ( R ):

Mean value	

Mean value	

Position of Rebound Tester

- Horizontal  
 Vertical  
 Inclined

Concrete Strength (N/mm<sup>2</sup>)  
(Cylinder compression strength)

--	--

Type of structural member:  **Superstructure**  **Cross Beam**  **Pile**

Single values ( R ):



Position of Rebound Tester

- Horizontal  
 Vertical  
 Inclined

Concrete Strength (N/mm<sup>2</sup>)  
(Cylinder compression strength)



Mean value
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Mean value
---------------

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Instruction:

1. Usually at least two measurement of each type of structural member
2. If obviously different surfaces of the same type of structural member then several measurements shall be made of this type

