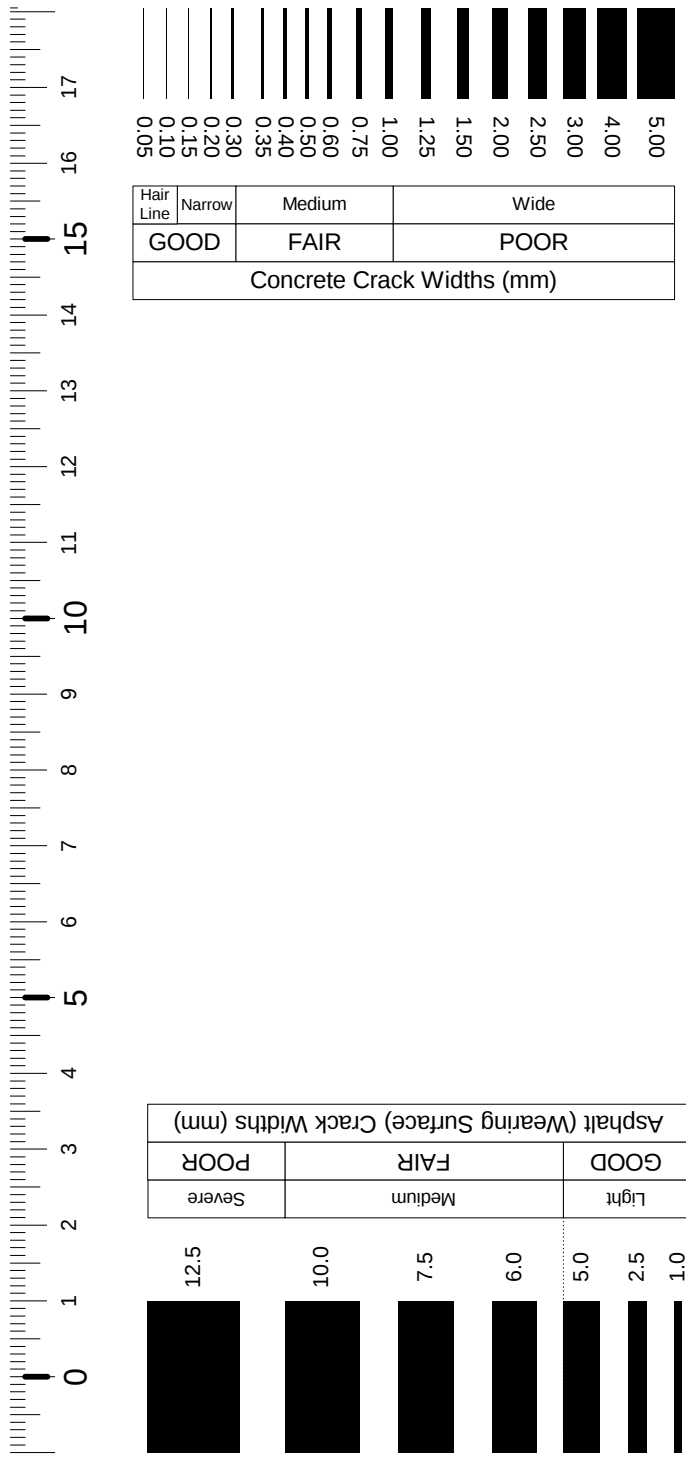
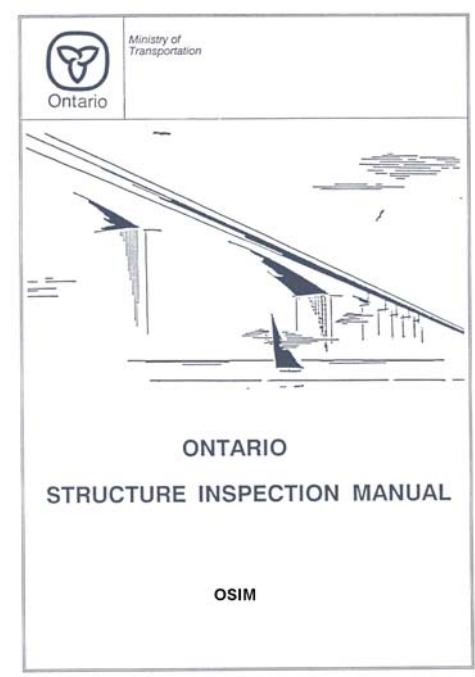




FIELD INSPECTION GUIDE



Apr 2008

Suggestions, comments, and requests for changes or revisions to the Field Guide or inquiries about training sources should be directed to:

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St. Catharines, Ontario L2R 7R4

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Apr 2008

Element Group:	Length:			
Element Name:	Width:			
Location:	Height:			
Material:	Count:			
Element Type:	Total Quantity:			
Environment:	Benign / Moderate / Severe			
Protection System:	Limited Inspection ☐			
Condition Data:	Units m ² / m / each / % / all	Exc.	Good	Poor*
Perform. Deficiencies				
Comments:				
Recommended Work:	☐ Rehab ☐ Replace ☐ 1-5 years ☐ 6-10 years		Maintenance Needs:	
			☐ Urgent ☐ 1 year ☐ 2 year	

PREFACE

The "Field Inspection Guide" is a condensed version of the "Ontario Structure Inspection Manual (OSIM).

It summarizes the major parts of the main manual including inspection procedures, material defects, condition states, maintenance needs and performance deficiencies.

References to the main manual are also made in this Field Guide so that the inspector can obtain more comprehensive information, if required.

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Overall Structure Notes:			
Recommended Work on Structure:	☐ None ☐ Minor Rehab. ☐ Major Rehab. ☐ Replace		
Timing of Recommended Work:	☐ 1 to 5 years ☐ 6 to 10 years		
Overall Comments:			
Date of Next Inspection:			

1. STRUCTURAL INSPECTIONS

1.1 INSPECTION OBJECTIVES (Part 1, Sect. 1.2)

The goal of the structural inspection is to ensure, within an economic framework, an acceptable standard for structures in terms of public safety, comfort and convenience. The main objectives are to:

- maintain structures in a safe condition
- prolong the life of structures
- identify maintenance & repair needs
- provide the basis for structure management

1.2 INSPECTION ACCURACY (Part 1, Sect. 1.3)

In order to achieve the inspection objectives and adequate accuracy, the inspector should spend at least 2 hours at a typical bridge site to adequately assess the condition of all elements.

The inspection should be a visual inspection performed "Close enough to determine the element condition", and generally conducted "within arms length" of the element.

In some cases it may be possible to inspect a portion of the bridge close-up and then estimating the condition of the remaining inaccessible parts by visually comparing them to the partial close-up inspection. If this is done, periodic Enhanced OSIM inspections must be done to closely inspect all components as described in Part 1, Section 1.3.2 of the OSIM.

Additional equipment should be used to facilitate inspection, when necessary (Bridgmaster, bucket truck, ladder, etc).

Additional specialized testing (NDT, etc) should be recommended for critical structures (fatigue prone, fracture critical, hangers, etc)

1.3 ADDITIONAL INVESTIGATIONS (Part 1– Clause 1.3.4)

If during a detailed visual inspection, the inspector feels that more detailed information is needed, specialized inspections (within a certain timeframe*)can be requested. Some of these investigations are:

- Detailed Deck Condition Survey
- Non-destructive Delamination Survey of Asphalt Covered Decks
- Substructure Condition Survey
- Detailed Coating Condition Survey
- Underwater investigation
- Fatigue investigation
- Seismic investigation
- Structure evaluation
- Monitoring, etc.

* Normal timeframe is within 2 years

1.4 SITE INSPECTION (Part 2-Clause 1.5.2)

The inspector shall:

- Arrange for **special equipment/traffic** control and safety devices, as required for site.
- Complete an overview inspection of the site to:
 - ⇒ Assess the **overall integrity** of the structure and identify areas where more detailed examination may be required
 - ⇒ Observe the bridge **under truck loading** and identify any abnormal flexibility, deflections or noises (rattling or vibration

	Priority		
	None	Normal	Urgent
Additional Investigations Required:			
Material Condition Survey			
Detailed Deck Condition Survey:			
Non-destructive Delamination Survey of Asphalt-Covered Deck:			
Concrete Substructure Condition Survey:			
Detailed Coating Condition Survey:			
Detailed Timber Investigation			
Post-Tensioned Strand Investigation			
Underwater Investigation:			
Fatigue Investigation:			
Seismic Investigation:			
Structure Evaluation:			
Monitoring			
Monitoring of Deformations, Settlements and Movements:			
Monitoring Crack Widths:			
Investigation Notes:			

Field Inspection Information:		Type of Inspection:	☐ OSIM	☐ Enhanced OSIM
Date of Inspection:				
Inspector:				
Others in Party:				
Access Equipment Used:				
Weather:				
Temperature:				

- ⇒ of members)
- ⇒ Look for **abnormal deflections**, settlements or rotations by looking along the rail or barrier wall or other members
- ⇒ Identify **obstacles** that may either interfere with the inspection or indicate a need for additional special equipment.

- Determine the **quantities** in each condition state based on the severity of material defects in the appropriate units (m2, each, etc.), for each element. Details of condition states and material defects are included in Appendix "A" and "C". The element list is included in Appendix "B" and the OSIM form for recording information is included in Appendix "E".
- Determine the **performance deficiencies**, maintenance needs, recommended work and time frame for work for each element. Details of these are included in the Appendix "D" of this Guide
- Take photographs to **adequately describe** the structure and the defects found including all areas of POOR.
- **Update element** quantities/dimensions if required.
- Correct missing/erroneous inventory data

1.5 POST INSPECTION PROCEDURES
(Part 2 - Clause 1.5.3)

The inspector shall:

- Ensure that all inspection equipment and temporary traffic control devices are removed from the site and the site is left in workmanlike order
- Ensure the appropriate follow-up action is taken (notify bridge owner immediately) for any critical structural defects or deficiencies (i.e. fatigue cracks in steel, imminent deck punch through, etc.) and all other unsafe conditions that are discovered in the field.
- Submit the Maintenance Needs list to the maintenance crew for action
- Ensure additional investigations are initiated in the timeframe recommended
- Write all necessary follow-up correspondence and reports

Comments		Appraisal Indices:	
		Fatigue	
		Seismic	
		Scour	
		Flood	
		Geometrics	
		Barrier	
		Curb	
		Load Capacity	

Scheduled Improvements:		
Regional Priority Number		Programmed Work Year
Nature of Program Work:		

2. HELPFUL HINTS (Part 2, Section 4)

1. CONDITION
- First look for areas of POOR
 - Concrete
 - ⇒ Spalls, delaminations, severe scaling, wide cracks (4m=1 sq.m defect area)
 - Steel
 - ⇒ More than 10% section loss, cracks and deformations
 - Actual inspection quantity (e.g. sq.m.) should be used for elements in Poor condition—not percent.
 - Next, look for areas of FAIR
 - Concrete
 - ⇒ Medium defects (medium scaling, medium cracks, etc.)
 - Steel
 - ⇒ 1% to 10% section loss
 - Each Area of Poor (except for very large areas) should generally have an equal area of associated Fair surrounding it.
 - Remainder of areas probably in Good or Excellent Condition.
 - Actual Good or Excellent depends on visual inspection; however, age of structure can be used as a guide, depending on environmental exposure of element (see section 2.2 of this guide).
 - Similar guidance based on age does not exist for the transition from Good to Fair Condition.
 - ⇒ Fair is determined by visual identification of defects.

Historical Data:	
Year Built	Year of Last Major Rehab.
Last OSIM Inspection	Last Evaluation
Last Enhanced OSIM Inspection	Current Load Limit (tonnes)
Enhanced Access Equipment (ladder, boat, lift, etc.)	Load Limit By-Law #
Last Underwater Inspection	By-Law Expiry Date
Last Condition Survey	
Rehab History: (Date/description)	

Inventory Data:		☐ On ☐ Under ☐ Crossing Type:		☐ Navig. Water ☐ Non-Navig. Water ☐ Rail
Structure Name				
Main Hwy/Road #				
Hwy/Road Name				
Structure Location				
Latitude				
Owner(s)	Longitude ☐ Not Cons. ☐ Cons./not App. ☐ List/not Desig. ☐ Desig./not List ☐ Design. & List			
MTO Region	Road Class: ☐ Freeway ☐ Arterial ☐ Collector ☐ Local ☐			
MTO District	Posted Speed ☐ No. of Lanes ☐			
Old County	AADT ☐ % Trucks ☐			
Geographic Twp.	Inspection Route Sequence ☐			
Structure Type	Interchange Number ☐			
Total Deck Length	Interchange Structure Number ☐			
Overall Str. Width	Min. Vertical Clearance ☐ (m)			
Total Deck Area	Special Routes: ☐ Transit ☐ Truck ☐ School ☐ Bicycle			
Roadway Width	Detour Length Around Bridge ☐ (km)			
Skew Angle	Direction of Structure ☐			
No. of Spans	Fill on Structure ☐ (m)			
Span Lengths	☐ (m)			

2. EXCELLENT AND GOOD

- All materials must begin in the Excellent condition state
- Once any defect is visible, it drops to the Good condition state
- The defects may not be visible from a distance, but are from close-up.
- Guidance is provided below for the age of component when transition* from Excellent to Good is expected:
 - Concrete, ACR Steel, Coated Steel, Coating:
 - **Severe—5 years**
 - **Moderate—15 years**
 - **Benign—25 years**
 - * Transition can be spread over a few inspections.
- Defects in Good condition state include (see Tables in Appendix C for complete list):
- **ACR Steel**
 - First signs of patina flaking
- **Coated Steel**
 - First signs of surface rust
 - First signs of coating lifting from steel
 - Re-coated steel that had rust previously
- **Coating**
 - First signs of adhesion or coating related defects
- **Concrete**
 - Hairline and Narrow cracks
 - Surface carbonization
 - Light scaling
 - Other light defects

Examples of Environments

OSIM FORMS
(Part 2, Section 7)

HINTS

Severe	Moderate	Benign
Exposed Concrete Deck	Concrete Deck with waterproofing	
	Exterior Soffit	Interior Soffit
Railings and inside face of Barrier Walls	Outside face of barrier wall	
Abutment in splash zone	Abutment at expansion joint	Abutment with no joint (integral abutment)
Pier in splash zone	Pier at expansion joint	Pier with no joint (where deck continuous)
	End Portion of Beams (at joints)	Remainder of Beams
Joints		

3. RECOMMENDED WORK (Part 2, Sect. 7)

Work on Element

Recommended work

- Must be consistent with condition of element.
- Must be used for elements that cause a bridge to be placed on a capital construction program, typically the 5 main elements listed below.
- Can be used for other elements as required.
- Must not be used for work that is carried out as maintenance.
- Must not be used for additional investigations or functional deficiencies.

Recommended work on an element can be either:

- "Rehabilitation"
- "Replacement"

The timeframe for the work is either:

- "1 to 5 years",
- "6 to 10 years"

Typically, the 5 main elements require repair in 1 to 5 years when:

Deck Top	10% to 20% Poor
Deck Soffit	5% to 15% Poor
Barrier Wall	15% to 30% Poor
Expansion Joint	15% to 25% Poor
Girders	5% to 10% Poor

- o Sometimes, a lower percentage of Poor may also trigger a rehab for critical elements.
- o If there are immediate safety concerns with some elements, a Structural Maintenance item should be recorded.

Work on Structure

Work on structure is only required when there is enough to warrant placing the bridge on the capital construction program.

Recommended work on the structure can be either:

- “Minor Rehabilitation” that include work on elements other than the deck (i.e. barriers, bearings, etc.)
- “Major Rehabilitation” that include work to the deck (i.e. patch-waterproof-pave, overlay, etc.) plus possibly other elements.
- “Replacement” of entire structure.

The timeframe for the work is either:

- “1 to 5 years”,
- “6 to 10 years”

	Maintenance Need	Description
8	Repair of Bridge Concrete	The repair of all concrete components of the structure, such as curbs, pedestrian walks, concrete handrail posts, parapet walls, abutments and piers, except when the repair is more directly associated with one of the other defined bridge maintenance operations or the quantity of repair is excessive for a maintenance operation.
9	Repair of Bridge Timber	The repair of all bridge timber, including the repair of timber decks on steel bridges.
10	Bailey Bridges – Installation, Maintenance and Removal	The installation, removal, repair and maintenance work that is unique to Bailey Bridges, but <u>not</u> including work defined by other structural maintenance operations.
11	Animal/Pest Control	The installation and maintenance of animal/pest control devices under bridge structures such as pigeon-proofing.
12	Bridge Surface Repair	The repair of bridge surfaces such as pothole patching.
13	Erosion Control at Bridges	Operations performed to prevent or repair damage due to erosion, such as scour at abutments and around piers, and washouts on slopes. Includes removal of obstructions to water flow, clearing of vegetation growth, extension of deck drains, etc.
14	Concrete Sealing	The sealing or treatment of bridge concrete surfaces with approved materials, as well as the preparation of surfaces prior to treatment.
15	Rout and Seal – Concrete and Asphalt Pavement on Bridge Decks	The routing of joints and/or cracks in concrete and asphalt pavement and the filling of same with joint fillers or rubberized asphaltic sealing compounds.
16	Bridge Deck Drainage	The repair, maintenance, and replacement of bridge deck drains. Includes steaming and calcium application to unthaw.
17	Scaling (Loose Concrete or ACR Steel)	The removal of loose delaminated concrete or delaminated patina of ACR steel girders that pose a risk as a falling hazard.
18	Other Maintenance	A maintenance activity that does not fit into any other category.

Table 6.1: Maintenance Needs (Part 2, Section 6)

Maintenance Need	Description
1 Lift and Swing Bridge Maintenance	The operation, maintenance and repair activities that are unique to lift and swing bridge structures, including all mechanical equipment and electrical devices such as signals, flashers, lighting, navigation lights, etc., but <u>not</u> including work defined by other structural maintenance operations.
2 Bridge Cleaning	The cleaning of bridge components including: 1) Washing of bearings, bearing seats, truss members, etc. 2) Sweeping of bridge decks, curbs and gutters. 3) Removal of debris from expansion joints. 4) Debris pick-up or minor removal of aggregate. 5) Cleaning of catch-basins, man-holes and deck drains.
3 Bridge Railing System Maintenance	The painting, repair and/or replacement of metal handrails, railing systems and posts, as well as touch-up painting activities.
4 Painting Steel Bridge Structures	The preparation (sandblasting, etc.) and painting of structural steel. Includes handrails when performed as part of an overall bridge painting operation.
5 Bridge Deck Joint Repair	The repair and/or replacement of expansion and/or fixed deck joints and end dams.
6 Bridge Bearing Maintenance	The adjustment, repair and/or replacement of bridge bearings. Includes all work directly associated with bridge bearings.
7 Repair to Structural Steel	The repair of all structural steel, including repair or replacement of steel components, bolts and fasteners.

4. PERFORMANCE DEFICIENCIES (Part 2, Section 6)

A Performance Deficiency should be recorded if an element's ability to perform its intended function is in question.

- "Suspected" Performance Deficiencies are recorded for each element
- Potential Deficiencies categorized as "Suspected" since often difficult to ascertain the significance of defect at the time of the inspection
- "Suspected" Performance Deficiencies usually indicate some follow-up action is required (strength evaluation, specialized inspection, monitoring, etc.)
- Standard List of possible deficiencies are shown on the inspection form (see Appendix D and Appendix E).
- Follow-up action can be addressed under "Additional Investigations" or "Special Notes" for the bridge.

Example:

A severely corroded girder at the midspan

- Can the girder safely carry traffic loading?
- Inspector cannot determine this in the field
- Inspector can only indicate "Suspected" Performance Deficiency for a follow-up strength evaluation
- Only then can decision be made whether bridge needs strengthening or posting

5. MAINTENANCE (Part 2, Section 6)

There are two types of maintenance work that are performed:

Structural Maintenance Work

- Is work to improve the structural capacity of a specific element and not part of a larger construction contract
- Is generally only done to one element
- Include emergency repairs and holding strategy repairs
- Is work that requires engineering drawings to complete the work.

Routine Maintenance Work

- Is for preventative maintenance and minor repair work that can be performed without engineering direction.
- Is usually carried out by bridge crews or road maintenance contractors

For all Maintenance work a standard list of maintenance needs are shown on the inspection form (see Appendix D, or Appendix E). The maintenance needs list should be forwarded to maintenance crews for action, with urgent items flagged for immediate attention.

14	Undermining of Foundation	Streams & Waterways or Foundation	Loss of material supporting foundations due to scour or erosion.	Underwater Investigation
15	Unstable Embankments	Embankments	- Settlement of embankment, slope protections or approach roadway; - Sliding failure of the toe or slopes of the embankment; - Surface or deep seated slips; - Loss of embankment material from under foundations.	Geotechnical investigation
16	Other			

Suspected Performance	Element Name (Examples)	Description of Deficiency	Possible Follow-up Action
13 Flooding/Channel Blockage	Streams & Waterways	• The inspector should look for the following evidence of high water levels, inadequate opening at the structure and adverse affects on other components of the structure: • Bending or buckling of the lower chord of steel trusses in the downstream direction by ice or heavy debris; • Ice scars and damage to substructures; • Coarse debris, such as branches and small trees, caught or wedged under the superstructure; • Fine debris, such as grass and twigs, on fences, trees, embankments, structures, etc.; • Wash lines on bare soil slopes; • Mud or silt deposited on embankments; • Marks and stains on structures.	• Determine historical frequency of flooding and recorded water levels and compare to current high water elevation • Monitor water elevations throughout year • Perform hydrology study

MATERIAL DEFECTS

This appendix contains a simplified table for material defects and condition states by combining the information from OSIM Part 1, Section 2 and Part 2, Section 4

TABLES

1.

Concrete
2.

Steel/Aluminum
3.

Wood
4.

Masonry
5.

Asphalt Wearing Surface
6.

Asphalt Covered Deck
7.

Coating

1. CONCRETE (Part 1, Sect. 2.2 and Part 2, Table 4.5)			
DEFECT	CONDITION STATE		
	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
Scaling	Local flaking/loss of surface portion of concrete or mortar due to freeze-thaw		
	Up to 5 mm depth	6 - 10 mm depth	> 10 mm depth
Disintegration	Physical deterioration or breaking down of the concrete into small fragments		
			All
Erosion	Deterioration of concrete brought about by water-borne sand and gravel particles scrubbing against surfaces		
			All
Corrosion of Reinforcement	Deterioration of reinforcement by electrolysis		
	Due to drains/chairs	Rust stains from reinforcement	Exposed reinforcement with rust
Delamination	Discontinuity of the surface concrete which is substantially, but not completely detached from concrete below or above it.		
			All

10	Surface Ponding	Sidewalk, Wearing surface	Water ponding on sidewalks/wearing surface, as it presents a safety hazard, especially if allowed to freeze;	Fill in depression with asphalt (Maintenance Operation)
11	Deck Drainage	Drainage System	- Deck drains not provided where necessary, or have inadequate size of opening; - Deck drains and drainage systems improperly constructed with inadequate slopes or sharp directional changes; - Drainage system plugged or partially plugged and not allowing for free and unobstructed flow of water; - Drainage outlets discharging directly onto structure components or roadways below the deck; - Drainage outlets discharging directly onto embankment without proper provision for collecting, channelling and controlling of discharge with splashpads, spillways or gutters; - Inadequate provision for drainage at the structure approaches.	Review deck drainage requirements
12	Slippery Surfaces	Deck Top	- Loss in riding comfort and potential loss of vehicle control due to defects in the component material; - Loss of protection to underlying surfaces due to defects in the wearing surface materials;	Resurface problem area (Maintenance Operation)

Table 5.1: Suspected Performance Deficiencies (Part 2, Section 5)

Suspected Performance	Element Name (Examples)	Description of Deficiency	Possible Follow-up Action
8 Pedestrian/ vehicular hazard	Armouring/ retaining devices, Sidewalk	- Vertical or horizontal misalignment across the joint; - Severe material defects (e.g. Spalling) - Horizontal, vertical or rotational displacements in curbs and sidewalks as they are hazardous to pedestrian and vehicular safety, and present obstructions to snow plows. - Inadequate curb height, or loss of curb height for sidewalks due to the placement of an additional layer of wearing surface or deck overlay	- Remove obstruction (Maintenance operation) - Review Code requirements for curb height
9 Rough Riding Surface	Wearing Surface, Approach slabs	- Rough approaches, settlement or consolidation of approach embankments, or deterioration of the approach slabs or ramps, resulting in vehicles "bouncing" onto the bridge. In addition to applying excessive dynamic loading to the bridge, this may also result in difficulty in maintaining vehicle control - Depressions and cracks in the roadway pavement above culverts and soil-steel structures;	- Smooth out asphalt at approach (Maintenance operation) - Strength evaluation

DEFECT	1. CONCRETE		
	CONDITION STATE		
Spalling	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
	Fragments which have been detached from a larger concrete mass		
Cracking			All
	Linear fracture which extends partly or completely through the member.		
Alkali-Aggregate Reaction	< 0.3 mm	0.3 - 1.0 mm wide	> 1.0 mm wide
	Aggregates react adversely with the alkalis in cement to produce a highly expansive alkali-silica gel		
	Hairline pattern cracks < 0.1 mm	Narrow pattern cracks 0.1 - 0.3 mm wide	Medium-wide pattern cracks > 0.3 mm wide

DEFECT	1. CONCRETE		
	CONDITION STATE		
	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE and VERY SEVERE)
Honeycombing	Produced due to the improper or incomplete vibration of the concrete which results in voids being left in the concrete where the mortar failed to completely fill the spaces between the coarse aggregate particles		
Pop-Outs	Holes up to 25 mm dia.	Holes 25 - 50 mm dia.	Holes more than 50 mm dia.
	Shallow conical depressions resulting from the breaking away of small portions of the concrete surface, due to the expansion of some aggregates due to frost action.		
	Holes up to 25 mm dia.	Holes 25 - 50 mm dia.	Holes more than 50 mm dia.

Suspected Performance Deficiency	Element Name (Examples)	Description of Deficiency	Possible Follow-up Action
5 Seized Bearings	Bearings	• Binding or jamming of expansion or rotational components due to corrosion, lack of lubrication or damage to sliding surfaces;	• Strength evaluation to account for change in articulation • Lubricate Bearings (Maintenance Operation)
6 Bearing not uniformly loaded/unstable	Elastomeric Bearing, Rocker Bearing, etc	• Non-uniform contact of bearing surfaces with each other or with bearing seat • Excessive inclinations of bearings	• Regular monitoring of bearing movements
7 Jammed expansion Joint	Armouring/retaining devices	• Inadequate joint gap to accommodate anticipated further movement; • Surfacing materials have jammed in the joints during resurfacing of deck; • Design or construction problems not allowing proper movement of multi-seal joints.	• Regular monitoring of deck movements • Clean out gap (Maintenance operation)

DEFECT	1. CONCRETE		
	CONDITION STATE		
	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE and VERY SEVERE)
Wear	Result of dynamic and/or frictional forces generated by vehicular traffic, coupled with the abrasive influx of sand, dirt and debris		
		ALL	
Slippery Concrete Surface	Smooth surface resulting from the polishing of the concrete deck surface by the action of repetitive vehicular traffic		
		ALL * include suspected performance deficiency of "slippery surface"	
Active Wet Areas	Concrete soffit surface is wet or damp		
		Wet but no cracks	Wet with cracks

		• Mis-alignment, lateral deformation, warping, etc. of components; • Inability of the abutment to withstand lateral earth pressures, as indicated by long, medium horizontal cracks in abutments; • Deformation of the roof slab, floor slab or walls of culverts. • Deformation of soil-steel structures such as flattening or peaking of the soffit or buckling of the shoulders or haunches; • Up-lift at ends of soil-steel structures • Movements causing distress in a bearing or it's components, or in other structure components;	
3 Continuing settlement	Foundation	• Loss of strength or support for applied loads due to material defects; • Loss of material supporting foundations due to scour or erosion • Consolidation or failure of underlying soil resulting in cracking or movement of foundations. abutments or piers • Loss of contact between piles and pile cap or pier cap; • Changes in the inclination of piles. • Rotational movement of pile caps and loss of full contact with piles.	• Regular Monitoring of settlement, pier and abutment elevations and crack widths • Strength evaluation • Geotechnical investigation • Underwater investigation

Table 5.1: Suspected Performance Deficiencies (Part 2, Section 5)

Suspected Performance Deficiency	Element Name (Examples)	Description of Deficiency	Possible Follow-up Action
1 Load Carrying Capacity	Girder, Deck Top, Railing System, etc	• Material defects leading to loss of strength, or which are indicative of inadequate strength of the component (eg.20% section loss at mid-span of girder) • Detrimental modifications made subsequent to construction; • Strong evidence of under design to current loads	• Strength evaluation • Monitoring of deformations (displacements or rotations) or cracks
2 Excessive Deformations	Railing System, Deck Top, Truss Chord, Abutment Wall, Bearings, etc	• Overloading, either single or repetitive occurrence, resulting in permanent deformations of the deck or deck components. • Permanent deformations, especially in compression components • Unanticipated or excessive vibration or deflection of components, connections or joints under live loads • Unexpected noise from components or connections due to vehicles moving across the structure.	• Strength evaluation • Monitoring of deformations (displacements or rotations)

2. STEEL/ALUMINIUM (Part 1, Sect. 2.3 and 2.6, Part 2 Table 4.15,4.16, and 4.17)

DEFECT	CONDITION STATE		
	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
Corrosion	Deterioration of steel by chemical/electro-chemical reaction resulting from exposure to air, moisture, de-icing salts, industrial fumes and other chemicals/contaminants in the environment in which it is placed		
	No section loss, loose rust/ pitting in paint -	< 10% section loss, small scales or flakes -	> 10% section loss, ex-tensive rust/ perforations
	Early signs of patina damage	Flaking of patina	
Permanent Deformations	Steel members can take the form of bending, buckling, twisting or elongation. Corrugate Steel Pipe (CSP) culverts can exhibit cusping (abrupt change in curvature, typically at seam), crimping (local buckling of culvert wall), global deformation (change in original curved shape), and bolt tilting (bearing failure of bolts).		
	For Members: ALL (Estimate repair area)		

Performance Deficiencies and Maintenance Needs

Wood Substructure or Superstructure	A detailed investigation of the wood components using techniques such as probing, drilling, coring, etc.	10% of element in "Poor" Condition State	Part 4 of this manual
Structural Steel Coating	A detailed survey of the condition of the coating to confirm the feasibility of over-coating. The survey involves testing coating adhesion, dry film thickness, etc. If deterioration is still in the early stages (Combined area of Fair and Poor greater than 25%, and Poor is less than 10% at the visual inspection stage), "over-coating" of the steel may be a viable rehabilitation option. This involves cleaning the surface with a wire brush and "over-coating" the entire surface. If deterioration exceeds the threshold, traditional coating techniques (sandblasting the surface, priming, etc.) would probably have to be used.	25% of combined area in "Fair" and "Poor" Condition States and also the percentage in Poor less than 10%.	Structural Steel Coating Manual

* This table indicates the material defect proportions that would generally trigger the need for a detailed condition survey to be done.

2. STEEL/ALUMINUM			
DEFECT	CONDITION STATE		
	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
		Cusping or crimping of culverts <10mm in height.	Cusping or crimping of culverts >10mm in height *
		Global Deformation <10% of culvert diameter	Global Deformation >10% of culvert diameter and reverse curvature *
		Bolt Tilting	
	Are linear fracture in the steel extending partially or completely through the member. They are mainly caused by fatigue, which can lead to brittle fracture (member cracks completely through without prior warning)		
Cracking	Cracks perpendicular to stress are very serious and should have immediate action taken.		
	ALL (Estimate repair area)		

2. STEEL/ALUMINUM			
DEFECT	CONDITION STATE		
	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
Connection Deficiencies	Loose connections can occur in bolted, riveted or clamped connections. They may be caused by corrosion of the connector, gusset plates or fasteners, excessive vibration, overstressing, cracking, or the lack of proper tightening during construction.		
	Based on the condition of the worst component within the connection		
	Depends on percentage of Loose Bolts or Plan Area with severe corrosion		
	< 5% loose bolts or severe rust	< 10% loose bolts or severe rust or cracks	> 10% loose bolts or severe rust or cracks

* - For CSP culverts, all portions in the Poor Condition State except corrosion without perforations (i.e. cupping, crimping, deformations, cracks and corrosion with perforations) the area shall be taken to include the entire circumference

S I C M D

Table 1: Material Condition Survey Triggers (Part 3)

Condition Survey Type	Description	Condition Survey Trigger	References
Concrete Deck (Asphalt or Concrete surface)	Involves the testing of various core samples, sawn samples and the delineation of delaminated areas and areas of high corrosion potential (using half-cell survey)	10% of element in "Poor" Condition State	Structure Rehabilitation Manual
Non-destructive Delamination Survey of Asphalt Covered Decks	Involves the delineation of delaminated areas using non-destructive testing techniques such as Ground Penetrating Radar, Impact Echo testing, etc	5% of element in "Poor" Condition State	Structure Rehabilitation Manual
Concrete Substructure	Involves the testing of various core samples, etc, and the delineation of delaminated areas and areas of high corrosion potential (using half-cell survey)	10% of element in "Poor" Condition State	Structure Rehabilitation Manual

Z O - I - D Z O O

Table 4.19: Wood – Substructures and Superstructures

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects	Light checks, splits and shakes *	Medium checks, splits and shakes *	Severe and very severe checks, splits and shakes *
	Light weathering	Medium weathering	Severe and very severe weathering
	Light rot or decay	Medium rot or decay	Severe and very severe rot or decay
	Light insect damage	Medium Insect Damage	Severe and very severe insect damage
	Light abrasion and wear	Medium Abrasion and wear	Severe and very severe abrasion and wear
	Light cracking, splintering, crushing and shattering	Medium cracking, splintering, crushing and shattering	Severe and very severe cracking, splintering, crushing and shattering
	Light fire and chemical damage	Medium fire and chemical damage	Severe and very severe fire and chemical damage
	Light connection deficiencies	Medium connection deficiencies	Severe connection deficiencies
* - These naturally occurring cracks in the wood, caused by shrinkage, are not as severe as overload cracking or splintering since wood fibres exist to bridge the crack and reduce the impact on the member capacity. The actual area containing the defect shall be determined for areas containing numerous defects. For isolated cracks, 8 m of crack length is equal to 1 square metre of defect for checks, shakes and splits; while 4 m of crack length is equal to 1 square metre of defect for cracking, splintering, crushing and shattering. The length of cracks, shakes, splits, etc. shall be measured on all surfaces.			Condition survey if area of deterioration in this state > 10%

Table 4.18: Streams and Waterways

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects	A few locations of scour or degradation of the stream bed or stream banks but not exposing the foundations	Numerous locations of scour or degradation of the stream bed or stream banks to the top of the previously covered foundations	Scour or degradation of the stream bed or stream banks to the bottom of previously covered foundations
	Slight scour at inlet or outlet of culverts and soil-steel structures	Moderate scour at the inlet or outlet of culverts and soil-steel structures	Extensive scour around the inlet or outlet of culverts and soil-steel structures with loss of embankment fill
	Stream alignment shifted but not encroaching against components previously not subject to stream flow	Stream alignment shifted and encroaching close to components not previously subject to stream flow	Stream alignment shifted with stream flow directly against most of a component not previously subject to stream
	A few locations of aggradation not affecting the stream flow at the structure	Medium aggradation having a significant effect on the stream flow at the structure	Extensive aggradation very severely affecting the stream flow at the structure)

Table 4.17: Steel or Aluminum - Railings

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects	Light corrosion – no section loss	Medium corrosion - up to 10% section loss	Severe and very severe corrosion – more than 10% section loss
	Slight loss of cable tension or slight slippage of cable anchors and splices	Moderate loss of cable tension or slight slippage of cable anchors and splices	Significant loss of cable tension or slight slippage of cable anchors and splices
			Broken cable strands/ supports
			Collision or vandalism damage/missing sections
			Permanent deformations
	Light connection deficiencies	Medium connection deficiencies	Severe connection deficiencies

3. WOOD (Part 1, Sect. 2.4 and Part 2 Table 4.19)			
DEFECT	CONDITION STATE		
	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
Weathering	Gradual deterioration of wood due to exposure to the actions of sun, rain, wind, frost and atmospheric pollutants		
Checks	Longitudinal tissue separations on the side grain of wood members		
Splits	Severe tissue separations extending from the side into the end		
Shakes	Tissue separations which follow the circular annual growth rings, and are visible on the end grain		
Weathering	< 5% into member	5—10% into member	> 10% into member
Checks, Splits, Shakes	< 5% into member	5—10% into member	> 10% into member
Rot or Decay	Biological decomposition of wood caused by micro-organisms called fungi		
	Slight change in colour but wood solid (<5% Section Loss)	Surface is discoloured and slight hollow sound (5% to 10% Section Loss)	Surface is fibrous or crumbly and hollow sounding or Surface and interior is crumbly and wood is weak (>10% Loss)

3. WOOD		
DEFECT	CONDITION STATE	
	GOOD (LIGHT)	FAIR (MEDIUM)
Insect Damage	Consequence of the tunnelling/boring by larvae/mature insects through the wood resulting in loss of section	
	Holes are present (<5% loss)	Holes and insects present (5% - 10% loss)
Abrasion and Wear	Deterioration of wood brought about by vehicles or snowplough blades scraping against wood surfaces, coupled with the abrasive influence of sand, dirt or debris.	
	< 5% loss	5% - 10% loss
Cracking, Splintering, Crushing and Shattering	Physical damage which results from vehicular collision from overloading of a member	
	< 5% loss	5% - 10% loss

Table 4.16: Steel or Aluminum – Substructures and Superstructures

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects	Light corrosion – no section loss	Medium corrosion - up to 10% section loss	Severe and very severe corrosion – more than 10% section loss
			All cracks (immediate action is required - estimate repair area)
			Permanent deformations
	Light connection deficiencies	Medium connection deficiencies	Severe connection deficiencies
			Evaluation and condition survey* if > 10% in this state.

* Involves measuring thickness of critical members to determine section loss as it varies across the element

Table 4.15: Steel – Atmospheric Corrosion Resistant Sub-structures and Superstructures

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects with smooth uniform rust layer (patina)	Early signs of patina flaking and no section loss	Flaking and delamination of Patina up to 10% section loss	More than 10% section loss
			All cracks
			Permanent deformations
	Light connection deficiencies	Medium connection deficiencies	Severe connection deficiencies
			Evaluation and condition survey* if > 10% in this state.

3. WOOD			
DEFECT	CONDITION STATE		
	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
Fire and Chemical Damage	Fire is evidenced by charring and is usually confined to the wood surface. Chemical damage may result from the use of non preservative chemicals on the wood surface over a long period of time		
	Slight charring or softening with < 5% section loss	Deeper charring or softening with slight loose connectors with 5% - 10% section loss	Extensive damage with loose and severely deformed connectors > 10% section loss
Connection Deficiencies	Connections are loosened due to repetitive or dynamic loads, wear or decay of members connected and corrosion of the connectors		
	< 5% loose bolts or severe rust	< 10% loose bolts or severe rust	> 10% loose bolts or severe rust

4. MASONRY (Part 1 Sect. 2.5, Part 2 Table 4.11)			
DEFECT	CONDITION STATE		
	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
Cracking	Incomplete separation into one or more parts with or without space between		
	< 0.3 mm wide	0.3 to 1.0 mm wide	> 1.0 mm wide
Splitting	The opening of seams or cracks in the stone leading to the breaking of the stone into large fragments		
Spalling	The breaking or chipping away of pieces of the stone from a larger stone		
Disintegration	Gradual breakdown of the stone into small fragments, pieces or particles		
Splitting, Spalling Disintegration	Hairline cracking and minor loss of stone surface with section loss < 50 mm	Narrow cracking or chipping away of stone with section loss 50 to 100 mm	Extensive spalling and disintegration of stone with section loss > 100 mm

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Table 4.14: Soil-Steel Structures

Excellent Condition	Good Condition	Fair Condition	Poor Condition*
No observed material defects		Medium Cusping or Crimping of corrugations (less than 10 mm in height)	Severe Cusping or Crimping of corrugations (greater than 10 mm in height)
		Medium Global Deformation (less than 10% of culvert diameter)	Severe Global Deformation (greater than 10% of culvert diameter or with reverse curvature)
		Bolt tilting	Cracks
	Light Corrosion (surface rust).	Medium Corrosion (Shallow pitting and corrosion scale over surface – less than 10% section loss)	Severe Corrosion (Deep pitting and corrosion scale over surface – greater than 10% section loss)

* - Unit of measure for soil-steel structures is m². The area of defect should be recorded for Severe Corrosion (excluding corrosion with perforations), as well as for the Excellent, Good and Fair Condition States. For all other portions in the Poor Condition State (cusping, crimping, deformations, cracks and corrosion with perforations) the area shall be taken to include the entire circumference. This is due to the importance of soil-steel interaction and continuity of the radial corrugations of steel where such a defect at one point on the culvert will affect the entire circumference.

Table 4.13: Slope Protection

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects	Loss or deterioration of less than 20% of slope protection material	Loss or deterioration of 20% to 60% of slope protection material	Loss or deterioration of more than 60% of slope protection material

4. MASONRY (Part 1 Sect. 2.5, Part 2 Table 4.11)			
DEFECT	CONDITION STATE		
	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
Loss of Mortar or Stone	Result of the destructive actions of frost, erosion, plant growth or softening by water containing dissolved sulphates or chlorides.		
	Mortar lost from joints in a few places to a depth of 20 mm	Mortar lost from joints over an extended area to a depth of 20 to 50 mm	Extensive mortar/stone loss endangering the stability of the structure

ASPHALT (Part 1, Sect. 2.7)

- Distinction made between rating the asphalt wearing surface and the deck top beneath the asphalt
- Asphalt defects are put into two major categories:
- **Top-Down Defects** (defect originates in asphalt and includes:)
 - Bond Defects (loss of bond and rippling)
 - Surface Defects (ravelling, slippery surface and flushing)
 - Surface Distortions (wheel track rutting)
 - Isolated Cracks (Light and medium isolated cracks)
- **Bottom-Up Defects** (defect probably originated in concrete deck and reflected in asphalt surface)
 - Pattern cracking (map, alligator, radial, edge cracking)
 - Wide isolated cracks (transverse, longitudinal)
 - Local Underlying Defects (local potholes and protrusions)

Table 4.12: Accessories

Excellent	Good	Fair	Poor
No observed defects	Not a standard sign	Not located according to standards	Illegible
			Gives misleading, wrong or inaccurate information
		Loose Components	Broken or missing components
			Sign is missing
	Light material defects	Medium material defects. Loose, damaged or bent components on attachments	Severe and very severe material defects. Broken or missing components on attachments

Table 4.11: Masonry Construction

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects	Hairline and narrow cracks	Medium cracks	Wide cracks
		Leaching of lime based mortar	
	Light splitting, spalling and disintegration	Medium splitting, spalling and disintegration	Severe and very severe splitting, spalling and disintegration
	Light loss of pointing mortar	Medium loss of pointing mortar	Severe and very severe loss of pointing mortar and stones

ASPHALT - CRACKING

- Linear Fracture extending partially or completely through the pavement caused by:
 - Wheel loading,
 - Poor material,
 - Poor compaction,
 - Frost action,
 - Drainage, or
 - Reflective crack (from crack below)
- Distinguished by crack appearance and direction

Longitudinal

Parallel to the direction of travel, and generally located at or near the centre of the wheel track or pavement edge

Transverse

Across pavement either fully or partially

Pattern Cracking

Series of cracks in close proximity to each other

Alligator

Network of multi-sided polygons, usually accompanied by depressions in the surface

Map

Cracks run randomly along pavement

Progressive edge

Cracks begin parallel to edge of pavement and lead to breaking up of the edge of pavement

Radial

Cracks in a radial pattern, usually about a depression.

5. ASPHALT WEARING SURFACE (Part 1 Sect. 2.7, Part 2 Table 4.1)				
DEFECT	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)	
Cracks	Pattern (e.g. Map, alligator, radial, edge) and isolated	Linear fracture extending partially or completely through the pavement		
		1—5 mm wide	6—10 mm wide	> 10 mm wide
Bond Defects	Loss of bond	Widespread loss of bond and delamination may occur between the asphalt pavement and deck surface, between the waterproofing and the deck surface, between the waterproofing and the asphalt pavement or between individual lifts of pavement		
		< 150 mm in diameter	150 to 300 mm in diameter	> 300 mm in diameter
	Rippling	The formation of transverse undulations in the pavement surface consisting of closely spaced valleys and crests		
		A few noticeable bumps	Several bumps producing a rough ride	Numerous bumps producing a very rough ride and difficulty maintaining control of vehicle

Table 4.10: Expansion Joint – Seals/Sealants

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects	Abrasions in seal with no perforations	Loss of resiliency of seal but no perforations	Cracks, tears or holes in the seal
			Seal has debonded
			Seal is allowing leakage on the substructure. Sealant debonded, pulled out or settled

Table 4.9: Expansion Joint – Armouring and Retaining Devices

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects	Light Corrosion*	Medium Corrosion*	Severe Corrosion* Bolts, anchors, armouring, clamping devices or welds are loose, broken or missing

* As defined in Table 4.16.

DEFECT	5. ASPHALT WEARING SURFACE (Part 1 Sect. 2.7, Part 2 Table 4.1)			
	GOOD (LIGHT)	FAIR (MEDIUM)	POOR	(SEVERE / VERY SEVERE)
Surface Defects	Ravelling	Progressive deterioration and loss of the pavement material from surface downward		
		Noticeable loss of pavement material	Shallow disintegration of pavement with an open texture appearance	Shallow to deep disintegration of pavement with small/ numerous potholes, open texture and loose surface material
	Slippery Surface	May result from flushing or from the polishing of the coarse surface aggregates by the action of repetitive vehicular traffic		
		There are no severity descriptions given for slippery surfaces as this is a serious and potentially hazardous situation resulting in loss of riding comfort and loss of vehicle control (indicate suspected perform deficiency of slippery surface)		
Flushing		The migration of asphalt upwards to the pavement surface in pavements with too much asphalt in the mix.		
	Visible colouring of the pavement surface occurring in localized areas	Distinctive colouring of the pavement surface with excess asphalt free on the pavement surface		
		Excessive free asphalt gives the pavement surface a “wet look”. Visible imprints left from footprints or vehicular traffic		

5. ASPHALT WEARING SURFACE (Part 1 Sect. 2.7, Part 2 Table 4.1)	
DEFFECT	GOOD (LIGHT) FAIR (MEDIUM) POOR (SEVERE / VERY SEVERE)
Surface Distortion	The formation of longitudinal depressions in the pavement at the locations of the wheel tracks of vehicles Rutting < 10 mm deep Rutting 10 to 20 mm deep Rutting > 20 mm deep
Local Underlying Defects	Potholes Bowl-shaped holes in the pavement caused by the penetration of water through the pavement and subsequent heaving of the pavement due to freezing of the entrapped water and breaking up of the pavement due to traffic action < 10 mm deep 10 to 20 mm deep > 20 mm deep
	Protrusions (Delaminations) Local delamination is visible as protrusions or bumps (often circular in shape) < 10 mm in height 10 to 20 mm in height > 20 mm in height

Table 4.8: Embankments

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects	Up to 10% loss of material for embankments not directly supporting foundations; or, up to 5% loss for embankments directly supporting foundations	10% - 30% loss of material for embankments not directly supporting foundations; or 5% to 15% loss for embankments directly supporting foundations; or, loss of material to the top of foundations	More than 30% loss of material for embankments not directly supporting foundations; or, more than 15% loss for embankments directly supporting foundations; or, loss of material to the bottom of foundations

Table 4.7: Drainage System

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects	Up to 20% of individual drainage system has loose or deteriorated components, connections or fasteners	20% to 60% of individual drainage system has loose or deteriorated components, connections or fasteners	More than 60% of individual drainage system has loose or deteriorated components, connections or fasteners Broken pipe components resulting in water draining onto substructure

DEFECT		5. ASPHALT COVERED CONCRETE DECK (Part 1 Sect. 2.7, Part 2 Table 4.6)		
		GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
Wide Isolated Cracks	Transverse, longitudinal cracks	Longitudinal – parallel to the direction of travel, and generally located at or near the centre of the wheel track , pavement edge or centre-line of bridge		
		Transverse – across pavement either fully or partially		
			> 10 mm wide single cracks	
Local - Underlying Defects	Potholes	Bowl-shaped holes in the pavement caused by the penetration of water through the pavement and subsequent heaving of the pavement due to freezing of the entrapped water and breaking up of the pavement due to traffic action		
				ALL
DE F	Protrusions (Delaminations)	Local delamination is visible as protrusions or bumps (often circular in shape)		
			ALL	
E C T S	Map, edge, alligator, radial	Incomplete separation into one or more parts with or without space between		
				ALL

6. ASPHALT COVERED CONCRETE DECKS			
DEFECT		GOOD (LIGHT)	POOR (SEVERE / VERY SEVERE)
		FAIR (MEDIUM)	
T O P - D O W N	Bond Defects	Loss of bond	Widespread loss of bond and delamination may occur between the asphalt pavement and deck surface, between the waterproofing and the deck surface, between the waterproofing and the asphalt pavement or between individual lifts of pavement
		ALL	
D E F E C T S	Rippling	The formation of transverse undulations in the pavement surface consisting of closely spaced valleys and crests	
		ALL	
	Surface Defects	Progressive deterioration and loss of the pavement material from the surface downward	
		ALL	
	Slippery Surface	May result from flushing or from the polishing of the coarse surface aggregates by the action of repetitive vehicular traffic	
		ALL	

Table 4.6: Concrete – Top of Deck Beneath Asphalt Wearing Surface

Based on Visual Inspection of Asphalt			
Excellent Condition	Good Condition	Fair Condition	Poor Condition
	All Bond Defects (e.g. rippling, loss of bond) in asphalt.		
	All Surface Defects (e.g. ravelling, flushing, slippery surface) in asphalt.		
	All Surface Distortions (wheel track rutting) in asphalt.		
			Condition survey if the area of deterioration in this state >10% if not already done.

Notes:

- (1) For all calculations, the actual area shall be determined for areas containing numerous cracks (i.e. alligator cracks, radial cracks). For isolated cracks, 4 m of crack length is to equal to 1 square metre of defect repair area.
- (2) If a bridge has been recently repaved without rehabilitating the deck, the inspector must estimate the condition of the concrete deck using other means. This would include using previous inspection information, the age of the waterproofing, deck condition survey data, etc.

Table 4.6: Concrete – Top of Deck Beneath Asphalt Wearing Surface

Based on Visual Inspection of Asphalt			
Excellent Condition	Good Condition	Fair Condition	Poor Condition
No Asphalt Defects.	Top-Down Asphalt Defects	Bottom-Up Asphalt Defects	
		Local protrusions in asphalt.	All Potholes in asphalt.
	Light and medium isolated cracks in asphalt.	Wide isolated cracks in asphalt. (Cracks include: longitudinal cracks, above location of voids, edge of beam flanges, joint between precast units, construction joints, etc., or transverse cracks)	All Pattern cracking in asphalt (e.g. map, alligator, radial, edge cracking).

DEFECT		6. ASPHALT COVERED CONCRETE DECKS		
		GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
T O P - D O W N D E F E C T S	Surface De- fects	Flushing	The migration of asphalt upwards to the pavement surface in pavements with too much asphalt in the mix.	
	Surface Dis- tortion	Wheel track rutting	The formation of longitudinal depressions in the pavement at the locations of the wheel tracks of vehicles	
	Light and Medium Isolated Cracks	Isolated cracks and Transverse, longitudinal cracks	Linear fracture extending partially or completely through the pavement	
		< 10 mm		

COATING

- Used to protect the underlying steel
- Not as much an immediate concern, but a durability concern
- Three main categories of defects:
 1. Coating related defect—related to the composition of the coating
 2. Adhesion related defect—related to the bond between the steel and coating
 3. Application related defect—poor appearance due to improper application

Table 4.5: Concrete – Substructures and Superstructures

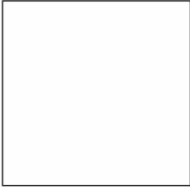
			Stable relative displacement between precast units. Leaking between precast units.	Active relative displacement between precast units
				All delaminated and spalled areas
			Active wet areas on soffit without cracks	Active wet areas or leachate deposits on soffit with associated cracks
Notes: (1) For all calculations, the actual area shall be determined for areas containing numerous cracks (i.e. pattern cracks, map cracks). For isolated cracks, 4 m of crack length is to equal to 1 square metre of defect repair area. (2) If shear cracks are found at girder ends, an evaluation should be done. If cracks are wide, the inspector should mark "URGENT" for the timeframe of the evaluation. As with other potentially unsafe conditions, the bridge owner should be notified if these cracks are noticed.				Condition Survey if area of deterioration in this state >10% for substructures
				Deck Condition Survey if area of deterioration in this state >10% for superstructures

Table 4.5: Concrete – Substructures and Superstructures

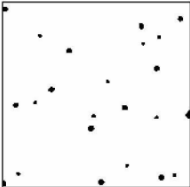
Excellent Condition	Good Condition	Fair Condition	Poor Condition
No observed material defects	Light scaling	Medium scaling	Severe to very severe scaling, erosion and disintegration
	Rust stains on concrete due to corroding rebar chairs	Rust stains on concrete due to corroding reinforcing steel	Medium to very severe corrosion of reinforcing steel
	Surface carbonation (Reaction with CO ₂ , associated discolouration, shrinkage and cracks)	Surface defects such as stratification, segregation, cold joints, abrasion, wear, slippery surfaces, wet areas and surface deposits (except on soffits).	
	Light honeycombing and pop-outs	Medium honeycombing and pop-outs	Severe to very severe honeycombing and pop-outs
	Hairline and Narrow cracks	Medium cracks	All wide cracks
	Light alkali-aggregate reaction	Medium alkali-aggregate reaction	Severe and very severe alkali-aggregate reaction

7. COATING (PART 1, Section 2.8 & Part 2 Table 4.4)				
DEFECT		GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
Rust Condition Rating		Ruts condition rating is a visual rating of the surface appearance and is based on ASTM D610 sketches and is also shown in Appendix C and OSIM Part 2, Figure 4.1		
		Rust Condition Rating 2	Rust Condition Rating 3	Rust Condition Rating 4 or more
Coating Related Defects	Checking or Crazing	Fine system of minute cracks in a checkerboard pattern. Caused by weathering and exposure during curing		
	Cracking		ALL	
	Alligatoring		ALL	
Chemical Attack			ALL	
Chalking			ALL	
		ALL		

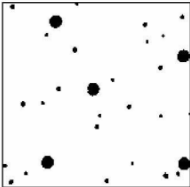
Category 1: No Rust
Condition State: Excellent



Category 2: Light Surface Rust
Condition State: Good



Category 3: Medium Surface Rust
Condition State: Fair



Category 4: Severe Surface Rust
Condition State: Poor

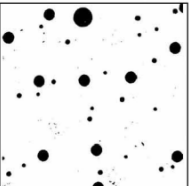


Figure 4.4b: Rust Condition Rating Categories for Coatings

Table 4.4a: Coating* - Structural Steel Substructures and Super-Structures

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No Observed Material Defects	Chalking	Checking, cracking, alligating	
		Intercoat delamination, peeling (top coat only)	Undercutting, blisters, peeling (prime coat), underfilm corrosion
		Signs of chemical attack	
	Overspray, runs, sags, pinholing	Bridging, edge defects, shadows	
RUST CONDITION** RATING CATEGORY 1	RUST CONDITION** RATING CATEGORY 2	RUST CONDITION** RATING CATEGORY 3	RUST CONDITION** RATING CATEGORY 4 or higher
Coating Condition Survey is required if combined area in the Fair and Poor Condition States is greater than 25% and the area in the Poor Condition State is less than 10% ***			

DEFECT		7. COATING (PART 1, Section 2.8 & Part 2 Table 4.4)		
		DEFECTS *		
Adhesion Related Defects	Undercutting	GOOD (LIGHT)	FAIR (MEDIUM)	POOR (SEVERE / VERY SEVERE)
		Spreading of corrosion under coating from a break. Caused by poor surface preparation		
	Blisters			ALL
		Dome shaped projections of coating. Caused by solvent or water trapped within paint film		
	Intercoat Delamination			ALL
		One coat separates from another. Caused by contaminated surfaces or excessive curing between coats		
Peeling			ALL	
		Separation of coating from steel due to poor adhesion		
				ALL
Underfilm Corrosion		Corrosion under the coating with the help of from a break. Caused by poor preparation or porous coating		
				ALL

DEFECT		7. COATING (PART 1, Section 2.8 & Part 2 Table 4.4)		
		DEFECTS *		
Application Related Defects	Bridging	GOOD (LIGHT)	FAIR (MEDIUM)	POOR SEVERE / VERY SEVERE)
		Coating bridges across tight corner or debris forming void. Void can trap moisture and oxygen		
	Edge Defects		ALL	
		Coating pulls away from sharp edges and corners. Due to insufficient application of coating at edge		
	Shadows		ALL	
Overspray		Coating is applied too thin in the shadow of a rivet, bolts, or other abrupt change in surface		
			ALL	
		Some paint particle outside spray pattern dry prior to full coating. Leads to some absorbed solvent and a more porous surface		
		ALL		

Table 4.3: Coating* – Steel Railings

Excellent Condition	Good Condition	Fair Condition	Poor Condition
RUST CONDITION** RATING CATEGORY 1	RUST CONDITION RATING CATEGORY 2	RUST CONDITION RATING CATEGORY 3	RUST CONDITION RATING CATEGORY 4 or higher

* Galvanized elements are included under the “Coating” category

** Rust Condition Ratings are shown in Figure 4.1. For additional information, see the Structural Steel Coating Manual.

*** In order to consider overcoating as a viable rehabilitation option, a detailed condition survey should be triggered before deterioration is too widespread.

Table 4.2: Bearings

Z O - I - D Z O O

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No Observed Material Defects	Hairline cracks in elastomeric pads	Narrow to medium cracks in elastomeric pads	Very wide cracks in elastomeric pads and/or steel plates debonded
	Light bulging or shear deformations in elastomeric pads, or light local deformation of roller/rocker plates	Medium bulging/shear deformations in elastomeric pads, or medium local deformation of roller/rocker plates	Severe bulging/shear deformations in elastomeric pads, severe local deformation of roller/rocker plates
	Light scoring/scratches in TFE or stainless steel	Medium scoring/scratches in TFE or stainless steel	Severe scoring/scratches or rips and tears in TFE or stainless steel
	Light Corrosion	Medium Corrosion	Severe and very severe corrosion and or cracks in steel
	Anchor bolts slightly bent	Anchor bolts severely bent/cracked	Anchor bolts are broken
	Guide bars and thrust plates slightly worn	Guide bars and thrust plates moderately worn	Guide bars and thrust plates severely worn and/or loose or missing nuts
	Up to 5% of bonded sliding surface is debonded	5% to 20% of bonded sliding surface is debonded	Over 20% of bonded sliding surface is debonded
			Internally confined compression material is squeezing/squeezed out

7. COATING (PART 1, Section 2.8 & Part 2 Table 4.4)	
DEFECTS *	
Application Related Defects	GOOD (LIGHT)
	FAIR (MEDIUM)
	POOR (SEVERE / VERY SEVERE)
	Pinholing Air bubbles trapped in coating creating voids. Caused by holding spray gun too close
	ALL
Runs	Downward movement of paint. Caused by over-thinning or depositing too much paint at one time
Sags	Similar to runs, the downward movement of 'curtain' of paint
Pinpoint Rusting	Rusting visible at point locations. Caused by insufficient coating thickness on peaks of blast cleaned substrate
Rate based on appearance and Rust Condition Rating	

S - I - O M M D

Table 4.1: Asphalt Wearing Surface

Excellent Condition	Good Condition	Fair Condition	Poor Condition
No Observed Material Defects	Light cracking	Medium cracking	Severe to very severe cracking
	Light ravelling	Medium ravelling	Severe and very severe ravelling
			All areas with loss of bond
	Light Potholes	Medium Potholes	Severe and very severe potholes
	Light wheel track rutting	Medium wheel track rutting	Severe and very severe wheel track rutting
	Light Rippling	Medium Rippling	Severe and Very Severe Rippling
	Light Flushing	Medium Flushing	Severe and very severe flushing

For all calculations, the actual area shall be determined for areas containing numerous cracks (i.e. alligator cracks, radial cracks). For isolated cracks, 4 m of crack length is to equal to 1 square metre of defect repair area.

APPENDIX C: MATERIAL CONDITION STATE TABLES (Part 2, Section 4)

Four Condition States have been defined for bridge elements, namely, Excellent, Good, Fair and Poor.

The condition of bridge elements is defined to be in any one or more of these Condition States. The “severity and extent” philosophy is used where, for each bridge element, the inspector assesses and records the amount (area, length or unit as appropriate) of the element in each of the four Condition States.

Table

- | | |
|------|---|
| 4.1 | Asphalt Wearing Surface |
| 4.2 | Bearings |
| 4.3 | Coating - Steel Railings |
| 4.4 | Coating - Structural Steel Substructures and Superstructures |
| 4.5 | Concrete - Substructures and Superstructures |
| 4.6 | Concrete - Top of Deck Beneath Asphalt Wearing Surface |
| 4.7 | Drainage System |
| 4.8 | Embankments |
| 4.9 | Expansion Joint - Armouring and Retaining Devices |
| 4.10 | Expansion Joint - Seals/Sealant |
| 4.11 | Masonry Construction |
| 4.12 | Accessories (Attachments and Signs) |
| 4.13 | Slope Protection |
| 4.14 | Soil-Steel Structures |
| 4.15 | Steel-Atmospheric Corrosion Resistant Substructures and Superstructures |
| 4.16 | Steel or <u>Aluminum</u> - Substructures and Superstructures |
| 4.17 | Steel or <u>Aluminum</u> - Railings |
| 4.18 | Streams and Waterways |
| 4.19 | Wood - Substructures and Superstructures |
| 1 | Material Condition Survey Triggers (<u>OSIM</u> Part 3) |

APPENDIX B

Element List and Condition State Cross Reference Table (Part 2, Ta-

Table 2.1: Element List and Condition State Cross Reference Table

Element Group	Element Name ^{6,7,8}	Unit for Quantity ^{1,2,3,4}	Applicable Condition State Table Number ⁵
Abutments	Abutment walls	Sq.m.	4.5, 4.11, 4.19
	Ballast walls	Sq.m.	4.5, 4.11, 4.19
	Bearings	Each	4.2
	Wingwalls	Sq.m.	4.5, 4.11, 4.19
Accessories (Attachments & Signs)	Bridge Mounted Sign Supports ⁹	Each	4.12
	Electrical ⁹	Each	4.12
	Noise Barriers	m ¹⁰	4.12
	Other	Each	4.12
	Signs	Each	4.12
	Utilities	Each	4.12
Approaches	Approach slabs	Sq.m.	4.5, 4.6
	Barriers ⁹	m ¹⁰	4.17, 4.19
	Curb and Gutters	m.	4.5
	Drainage System	Each	4.7
	Sidewalk/Curbs	Sq.m.	4.5
	Wearing surface	Sq.m.	4.1, 4.5, 4.6
Barriers	Barrier/Parapet Walls	Sq.m.	4.5
	Hand Railings	m. ¹⁰	4.17
	Posts	Each	4.5, 4.16, 4.19
	Railing Systems	m. ¹⁰	4.17, 4.19
Beams/Main Longitudinal Elements	Diaphragms	Each (Sq.m if Concrete)	4.5, 4.15, 4.16, 4.19
	Floor beams	Sq.m.	4.5, 4.16, 4.19
	Girders	Sq.m.	4.5, 4.15, 4.16, 4.19
	Inside boxes (sides & bottom)	Sq.m.	4.5, 4.15
	Stringers	Each	4.5, 4.16, 4.19
Bracing	Bracing	Each	4.15, 4.16, 4.19
Coatings	Railing Systems / Hand Railings	Sq.m.	4.3
	Structural Steel	Sq.m.	4.4
Culverts	Barrels	Sq.m.	4.5, 4.14
	Inlet Components	Sq.m.	4.5
	Outlet Components	Sq.m.	4.5
Decks	Deck Top	Sq.m.	4.5, 4.6, 4.19
	Drainage System	Each	4.7
	Soffit – Inside Boxes	Sq.m.	4.5
	Soffit – Thick slab	Sq.m.	4.5
	Soffit – Thin Slab	Sq.m.	4.5, 4.19
	Wearing Surface	Sq.m.	4.1
Embankments & Streams	Embankments	Each	4.8
	Slope protection	Each	4.13
	Streams and Waterways	All	4.18
Foundations	Foundation (below ground level)	N/A	Rate performance only.
Joints	Armouring/retaining devices	m.	4.9
	Concrete end dams	Sq.m	4.5
	Seals/sealants	each	4.10

Element Group	Element Name ^{6,7,8}	Unit for Quantity ^{1,2,3,4}	Applicable Condition State Table Number ⁵
Piers	Bearings	Each	4.2
	Caps	Sq.m.	4.5, 4.11, 4.16, 4.19
	Shafts/columns/Pile Bents	Sq.m.	4.5, 4.11, 4.16, 4.19
Retaining walls	Barrier Systems on walls	Sq.m.	4.5, 4.17, 4.19
	Railing Systems	m ¹⁰	4.17, 4.19
	Drainage Systems	All	4.7
	Walls	Sq.m.	4.5
Sidewalks/curbs	Curbs	Sq.m.	4.5
	Sidewalks and medians	Sq.m.	4.5
Trusses/Arches	Bottom chords	Sq.m.	4.5, 4.16, 4.19
	Connections	Each	4.16, 4.19
	Top chords	Sq.m.	4.5, 4.16, 4.19
	Verticals/diagonals	Sq.m.	4.5, 4.16, 4.19

Notes: 1 – For "All", place the entire component (100%) in one condition state.
2 – For "Each", give the number of occurrences of the component in each state.
3 – For cracks in concrete, estimate repair area (4m of crack = 1 sq. m of repair).
4 – For cracks in steel, estimate required repair area.
5 – Tables given are typical for element. Use appropriate table for applicable material. (See Section 4).
6 – Sub-elements (End/Middle) to be used for the following elements at expansion joint locations: Deck Top, Girders, Inside Boxes
Sub-elements (End/Intermediate) to be used for the following elements at expansion joint locations: Floor Beams, Stringers, Bracing and Diaphragms
Sub-elements (End/Interior/Exterior) to be used for Soffits
Sub-elements (Interior/Exterior) to be used for Barrier/Parapet Walls
7 – For an explanation of which bridge components are included in each element, see Table 3.1.
8 – Similar element types should be grouped together (e.g. I-girders, x-frames, etc.)
9 – Optional element. Not required for MTO use
10 – For these elements that are inspected by linear metre, a defect in the post shall be assumed to affect the tributary area for that post.