



**TMH19**

**MANUAL FOR THE VISUAL  
ASSESSMENT OF ROAD  
STRUCTURES**

**Draft Standard (DS)**

**PART B: VISUAL ASSESSMENT GUIDE**

**August 2020**

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# Foreword

## Compiled under the auspices of the:

Committee of Transport Officials (COTO)  
Roads Coordinating Body (RCB)  
Structures Subcommittee

## Published by:

The South African National Roads Agency SOC Limited  
PO Box 415, Pretoria, 0001

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Not Applicable

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**Draft Standard (DS).** The Draft Standard will be implemented in industry for a period of two (2) years, during which written comments may be submitted to the COTO subcommittee. Draft Standards (DS) have full legal standing.

**Final Standard (FS).** After the two-year period, comments received are reviewed and where appropriate, incorporated by the COTO subcommittee. The document is converted to a Final Standard (FS) and submitted by the Roads Coordinating Body (RCB) to COTO for approval as a final standard. This Final Standard is implemented in industry for a period of five (5) years, after which it may again be reviewed. Final Standards (FS) have full legal standing.

## Comments:

Comments on this Draft Standard should be provided in writing and e-mailed to [admin.coto@durban.gov.za](mailto:admin.coto@durban.gov.za)

## Please note:

This document and its various Parts will only be available in electronic format.  
The Draft Standard (DS) will be made available for download on the South African National Roads Agency SOC Ltd (SANRAL) and Department of Transport websites.  
The MS Word version of this document is available from Michael Roux at [mproux@csir.co.za](mailto:mproux@csir.co.za).

***PLEASE NOTE THAT THE DOCUMENT SHOULD BE PRINTED DOUBLE SIDED SO THAT THE DEFECT DESCRIPTIONS AND DEFECT PHOTOS IN SECTION 1.2 ARE PRINTED ON OPPOSING PAGES FOR EASE OF REFERENCE***

## Preface

Road authorities in South Africa have an obligation to plan, design, construct and maintain the road network, to protect the public investment in the road infrastructure, to ensure the continued functionality of the transportation system and to promote the safety of traffic on the road network. Authorities also have the obligation to provide a reliable, effective, efficient and integrated transport system that supports the sustainable economic and social development of the country.

Road structures are an integral part of the road network. This Manual provides the official requirement for the visual assessment of road structures on the South African road network. It provides requirements and supporting information for the inventory data capturing, explains the inspection methodology and describes how and by whom inspections for the visual assessment of road structures have to be carried out. It further addresses repair costs calculations.

Structures covered by this manual include:

- Bridges;
- Culverts;
- Retaining Walls;
- Gantries;
- Tunnels;
- Low level bridges;
- Light Masts; and
- Low level river crossings.

The inspection methodology described in this manual is a defects-based system and involves the identification of visual defects on structures and rating these defects in terms of degree, extent of occurrence and relevancy.

The relevancy of defects is very important in the rating process and is considered in terms of structural and functional integrity and the safety of the road user.

This manual is a companion document to the TMH22 Manual on Road Asset Management. The TMH22 manual includes sections on how inspection ratings are used to calculate condition indices for road structures at network level and how to calculate the current asset value of these road structures.

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# Overview of the Manual

TMH19 consists of two separate parts, Part A and Part B.

**Part A: Road Structure Management Information** covers the following topics:

- Structure Class and Type Definitions;
- Overview of Structures Management System (SMS);
- Inventory Information;
- The DER Rating System;
- Overview of Defects on Structures;
- Inspection Items and Inspection Sheets;
- Inspection Procedure and Quality Assurance; and
- Repair Cost Calculations.

The following additional information is supplied in the appendices:

- Detail of the inventory information that can be captured per structure type, indicating required and optional items;
- Inspection forms to be used for the various structure types; and
- Remedial work activity lists for the various structure types.

Part B is a visual assessment manual intended for use as reference document by structure inspectors to reduce the amount of subjectivity involved in the inspection process. It can also assist in the training of inspectors. It includes sections with photos of defects on the structural elements for the various structure types. These photos are intended to mainly illustrate the Degree rating, but the Extent, Relevancy and Urgency ratings are also shown as examples of these ratings. Descriptions of the various defects are provided.

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## **1 Introduction**

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### **1.1 Background**

The aim of this Visual Assessment Guide is to assist inspectors when doing visual assessments of bridges, culverts, gantries, retaining walls and tunnels. The emphasis of the guide is to provide a benchmark for the rating of the degree (D) of various defects in the DER rating system.

While the visual assessment guide is intended for use by inspectors carrying out visual assessments of structures using the DER-rating methodology, it can also be used for the training of inspectors.

This document consists of a photographic guide of defects per inspection item for the various structure types, with a description of the defects and the degree ratings. The photographs are intended to mainly illustrate the Degree rating, but the Extent; Relevancy; and Urgency ratings are also shown as examples of these ratings.

### **1.2 Degree Ratings**

The **Degree rating (D)** describes how bad or severe is the defect being rated. It is a visual rating that defines the severity of the defect. It is not clouded by the need to consider the consequence of the defect with regards the inspection item and structure concerned. Rating the degree of the defect separately allows for the monitoring of the deterioration of the defect over time.

The possible values for D are given in the table below:

<b>D – Degree</b>						
Not applicable	Unable to inspect	No visible defects	Minor	Moderate	Warning	Severe
X	U	0	1	2	3	4

For each inspection item, a D-rating has to be allocated. If the D-rating is 0; X; or U, then no E-rating and R-ratings are given. If the D-rating is 1; 2; 3 or 4, an E-rating and an R-Rating have to be given.

## **2 Photographic Guide of Defects per Structure Type and Inspection Item**


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This section contains photos of defects for all the inspection items of the various structure types. The photos are primarily intended to illustrate the Degree rating, but the Extent, Relevancy and Urgency ratings are also provided as examples of these ratings.

This section currently contains limited photos for retaining walls; gantries; and road tunnels and no photos for light masts, as there have been very few inspections of these structure types in the past. This section will be updated once more inspection photos for these structure types become available.









## 2.1 Bridge (General)

<b>Item 1 Approach Embankment Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Scour or erosion of embankment	Scour or erosion is shallow. There is no possibility of local collapse.	1
	Scour or erosion is shallow. Sides appear stable. There is a small possibility of local collapse.	2
	Scour or erosion is deep. There is a possibility of local collapse.	3
	Scour or erosion is deep. Sides are vertical or overhanging. Sides appear unstable. There is a real possibility of local collapse, which would endanger the roadway.	4
Settlement of approach fill	Settlement is not more than 50 mm.	1
	Settlement is greater than 50 mm but smaller than 100 mm.	2
	Settlement is more than 50 mm but smaller than 100mm. There is an abrupt step of the same magnitude in the riding surface at the abutment screen (bearing sill) wall.	3
	Settlement is greater than 100 mm. There is an abrupt step of the same magnitude in the riding surface at the abutment bearing sill wall.	4
Kerbs, berms and/or down chutes	Kerbs, berms or down chutes are ineffective due to the collection of debris and/or vegetation or due to minor damage.	1
	Kerbs, berms or down chutes are moderately damaged.	2
	The damage on kerbs, berms or down chutes has reached a warning state.	3
	Kerbs, berms or down chutes are severely damaged.	4
Trees and vegetation	Trees and vegetation can be detrimental to the integrity of the approach embankment as well as contribute to reduced site distances etc.	
	Minor	1
	Moderate	2
	Warning	3
	Severe	4

<b>Item 1: Approach Embankment Defect Photos</b>		
D = 1		
Left DER-U 121-1		
Right DER-U 121-2		
	Erosion alongside bridge stone pitching	Erosion behind wing wall
D = 2		
Left DER-U 222-3		
Right DER-U 222-2		
	Settlement of approach fill – 50 to 100mm	Erosion encroaching on road
D = 3		
Left DER-U 323-4		
Right DER-U 333-3		
	Deep scour encroaching on road	Deep erosion behind wing wall
D = 4		
Left DER-U 443-3		
Right DER-U 434-4		
	Major erosion of embankment	Deep scour, sides are vertical or overhanging

**Bridge (General)**









<b>Item 2 Guardrail Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Defective guardrail	Guardrails are not attached to the bridge parapet end blocks.	4
	Guardrails are poorly attached to the bridge parapet end blocks.	2-3
	Guardrail posts are cracked or broken.	2-3
	Guardrail posts are missing.	4
	Bolts/nuts are loose.	1-2
	Nuts are missing.	2-3
	Wood spacer blocks are misaligned.	1-2
	Wood spacer blocks are missing.	2-3
	Guardrails are damaged, bent or broken.	1-4
	Guardrails are corroded.	2-3
Laps need to be reversed.	4	

Item 2		Guardrail Defect Photos	
D = 1			
Left DER-U 131-2			
Right DER-U 111-2			
	Missing fixing nuts	Reposition loose spacer block	
D = 2			
Left DER-U 212-3			
Right DER-U 222-3			
	Fix guardrail to end block	Fix to end block, corrosion and missing posts	
D = 3			
Left DER-U 313-3			
Right DER-U 313-3			
	Guardrail extensively damaged	Fix guardrail to NJ barrier	
D = 4			
Left DER-U 413-3			
Right DER-U 414-4			
	Accident resulting in guardrail displacement	Guardrail protrusion into roadway (MS)	

**Bridge (General)**

<b>Item 3 Waterway Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Flood debris accumulation	Loose debris accumulating on piers or bridge decks.	1
	Debris accumulation in the form of small branches on piers or on bridge decks.	2
	Debris accumulation in the form of large branches or small trees on piers or on bridge decks.	3
	Debris accumulation in the form of large trees on piers or on bridge decks.	4
Siltation	Siltation reduces the flood capacity of the bridge	
	Moderate	2
	Warning	3
	Severe	4
Vegetation growth within the waterway	Reeds, bushes and trees growing within the bridge waterway reducing the flood capacity of the bridge.	
	Minor (Reeds and bushes)	1
	Moderate (Reeds and bushes)	2
	Warning (Bushes and trees)	3
	Severe (Bushes and trees)	4








**Item 3 Waterway Defect Photos**

D = 1		
Left DER-U 111-2		
Right DER-U 111-2		
Vegetation and gate in waterway		Debris and vegetation in waterway
D = 2		
Left DER-U 232-2		
Right DER-U 222-2		
Inlets clogged by debris		Original scaffold founding blocking waterway
D = 3		
Left DER-U 333-3		
Right DER-U 333-3		
Inlets clogged by debris		Debris and tree blocking waterway
D = 4		
Left DER-U 443-4		
Right DER-U 432-3		
Siltation blocks waterway		River relocation

**Bridge (General)**

<b>Item 4 Approach Embankment Protection Works</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Defective embankment protection works.	<p>Embankment protection materials can comprise:-</p> <ul style="list-style-type: none"> <li>• Gabion mattresses and/or boxes</li> <li>• Stone pitching</li> <li>• Grouted stone pitching</li> <li>• Interlocking concrete paving blocks</li> <li>• Concrete edge beams and channels</li> <li>• Concrete slabs</li> <li>• Precast concrete retaining blocks</li> <li>• Geocells</li> <li>• Interlocking cellular concrete grass blocks</li> </ul>	
	<p>General defects include:-</p> <p>Vegetation growth within the protection works can damage the protection works and is aesthetically a problem.</p>	1-3
	<p>Portions of the protection works are missing or have been damaged; they may have been removed by vandals or have eroded away.</p>	2-3
	<p>Protection works were never provided or have been completely removed. In river bridges the abutment stability may be compromised.</p>	3-4
Scour or erosion of embankment	<p>Scour or erosion is shallow. There is no possibility of local collapse.</p>	1
	<p>Scour or erosion is shallow. Sides appear stable. There is a small possibility of local collapse.</p>	2
	<p>Scour or erosion is deep. There is a possibility of local collapse.</p>	3
	<p>Scour or erosion is deep. Sides are vertical or overhanging. Sides appear unstable. There is a real possibility of local collapse, which would endanger the roadway.</p>	4









**Item 4 Approach Embankment Protection Works Photos**

D = 1		
Left DER-U 131-2		
Right DER-U 121-2		
Vegetation on embankment protection works		Interlocking blocks removed
D = 2		
Left DER-U 242-2		
Right DER-U 232-2		
Embankment protection works taken away		Stone pitching damaged and under-soured
D = 3		
Left DER-U 333-3		
Right DER-U 332-2		
Embankment protection works not provided		Gabion mattress damaged and washed away
D = 4		
Left DER-U 433-3		
Right DER-U 443-3		
Embankment/slope protection works removed		Embankment protection works washed away

## Bridge (General)

Item 5 Abutment Foundation Defects		
Defects	Observations	D
Shrinkage and restraint cracks including AAR (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Shear cracks  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is visible of the order of 0.1 to 0.2 mm and there are no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.2 mm but smaller or equal to 0.4 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is greater than 0.4 mm with no signs of water leakage or corrosion of reinforcement.	3
	Crack is greater than 0.5 mm and there are signs of water passing through crack and/or evidence of corrosion of reinforcement.	4
Bending cracks  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Honeycombing  (If possible, areas of honeycombed concrete must be removed to expose full extent of damage)	Honeycombing is shallow and reinforcement is not visible.	1
	Honeycombing is shallow. Reinforcement is partly exposed. No signs of corrosion.	2
	Reinforcement is fully exposed, with some signs of corrosion; or reinforcement is partly exposed and corroded. Prestress duct is partly exposed.	3
	Reinforcement is exposed and corroded. Prestress duct is exposed.	4
Scour of foundations	Local scour at pier foundation is shallow. Scour has not exposed base of foundation.	1
	Local scour at pier foundation is shallow. Scour has partly exposed base of foundation or piles of piled foundation.	2
	Local scour at pier founded on piles has exposed the piles. Scour has exposed erodible founding material of a spread footing on a small portion of the perimeter of footing.	3
	Scour has exposed erodible founding material of a spread footing which might cause the footing to collapse or settle.	4









**Item 5 Abutment Foundation Defect Photos**

D = 1		
Left DER-U 111-2		
Right DER-U 131-2		
	Crack in abutment foundation	Local scour of foundation
D = 2		
Left DER-U 212-2		
Right DER-U 231-2		
	Crack in abutment foundation	Honeycombing in foundation
D = 3		
Left DER-U 323-4		
Right DER-U 332-3		
	Crack in abutment foundation	Scour of abutment foundation
D = 4		
Left DER-U 443-3		
Right DER-U 433-3		
	Vertical crack in abutment foundation	Scour of abutment foundation

**Bridge (General)**

<b>Item 6 Abutment Defects</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Prestress duct is exposed. Section loss.	4
Shrinkage and restraint cracks including AAR  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4

**Item 6 Abutment Defect Photos**

D = 1		
Left DER-U 111-2		
Right DER-U 111-2		
	Crack in abutment wall	Local spall in abutment wall
D = 2		
Left DER-U 211-2		
Right DER-U 222-3		
	Vertical crack in abutment wall	AAR cracking in return wall
D = 3		
Left DER-U 311-2		
Right DER-U 312-3		
	Vertical crack in abutment return wall	Spalling at abutment return wall
D = 4		
Left DER-U 413-3		
Right DER-U 433-3		
	Vertical crack in abutment wall	AAR in abutment wall

**Bridge (General)**

<b>Item 7 Wing/Retaining Wall Defects</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Shrinkage and restraint cracks including AAR  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Section loss.	4






**Item 7 Wing/Retaining Wall Defect Photos**

D = 1		
Left DER-U 111-2		
Right DER-U 111-2		
	Diagonal crack in wing wall	Spalling at wing wall joint
D = 2		
Left DER-U 211-2		
Right DER-U 211-3		
	Diagonal crack in wing wall	Spalling on wing wall
D = 3		
Left DER-U 312-3		
Right DER-U 312-3		
	Diagonal crack in wing wall	Spalling at wing wall joint
D = 4		
Left DER-U 414-4		
Right DER-U 442-3		
	Restraint crack in wing wall	AAR cracking in wing wall

## Bridge (General)

<b>Item 8 Surfacing Defects for Bridges and Culverts</b>		
<p>The surfacing area that should be assessed with this inspection item includes only the surfacing area on the bridge deck (between abutment expansion joints) or directly above a culvert. The surfacing area on the approaches or road below the bridge/culvert is not included.</p>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Cracking	<p>This could be an indication of failure of the surfacing material, or indicates excessive movement or deterioration of the underlying deck. With time, crumbling of the surfacing material along the edges of the cracks takes place and the ingress of water may lead to loss of adhesion between the surfacing and the deck.</p>	
	<p>The defects in the surfacing will not likely cause an accident on the bridge.</p>	1-2
	<p>The defects in the surfacing could likely cause an accident on the bridge.</p>	3-4
Excessive deformation	<p>This will take place due to the combined effects of traffic and warm weather or due to loss of adhesion at the interface with the deck or waterproofing membrane. When the deformation becomes excessive, it impairs riding quality and in turn can substantially increase the dynamic loading and vibration from moving vehicles.</p>	
	<p>The defects in the surfacing will not likely cause an accident on the bridge.</p>	1-2
	<p>The defects in the surfacing could likely cause an accident on the bridge.</p>	3-4
Loss of skid resistance	<p>Because of polishing under traffic, the surfacing will become more slippery with time and re-treatment of the surface will be required to restore the resistance to skidding. The standard of this resistance on bridges should be high because of the likely serious consequences of skidding accidents on bridges.</p>	
	<p>The defects in the surfacing will not likely cause an accident on the bridge.</p>	1-2
	<p>The defects in the surfacing could likely cause an accident on the bridge.</p>	3-4

**Item 8 Surfacing Defect Photos For Bridges And Culverts**

D = 1		
Left DER-U 131-1		
Right DER-U 121-1		
	Gravel accumulated on deck	Vegetation growing on deck
D = 2		
Left DER-U 222-2		
Right DER-U 232-2		
	Loss of skid resistance due to bleeding	Cracking of road surface
D = 3		
Left DER-U 322-3		
Right DER-U 323-3		
	Loss of surfacing on deck (potholes)	Large cracks and potholes in surfacing
D = 4		
Left DER-U 414-4		
Right DER-U 423-3		
	Walkway surface panel missing (MS)	Severe cracks and potholes in surfacing

## Bridge (General)

### Item 9 Superstructure Drainage Defects

Drainage is an important item for inspection, since trapped, ponded, flowing or splashing water can cause damage to the bridge over a long period and represent a safety hazard to traffic. The main defects include the following:

- a. Water stains on beams, slabs, piers and abutments may indicate inadequate drainage systems or leaking expansion joints.
- b. Blocked or inadequate drainage gullies and pipes.
- c. Drain outlets should be checked to ensure that water is not discharged where it may be detrimental to other components of the structure or on traffic below the bridge.
- d. The accumulation of debris in drainage systems.
- e. Wind blowing drainage water on structure.
- f. Drainage gullies/scuppers should be able to drain water from the deck surface. Resurfacing operations may restrict or block the water flow.
- g. In voided decks, drain pipes should be provided to remove water from the lowest points of voids.

Defects	Observations	D
Drain is partly silted up.	Water flow is restricted but drain is still functional.	1
Drain is in the order of 50% blocked.	Water flow is restricted.	2
Drain is almost completely blocked.	Water flow severely restricted.	3
Drain is completely blocked up or not provided where required.	No water flow can take place. Ponding may occur causing aquaplaning at high speed.	4
Drain pipes not protruding past deck soffit.	Result in streaking and staining of deck. Cyclical wet and dry conditions may aggravate concrete deterioration and result in cracking and spalling, especially where ASR is present in the concrete.	2-4

<b>Item 9 Superstructure Drainage Defect Photos</b>		
D = 1		
Left DER-U 111-2		
Right DER-U 141-2		
	Scupper grid missing	No drip notch provided on cantilever
D = 2		
Left DER-U 242-2		
Right DER-U 212-1		
	Drainage pipes flush with deck soffit	Partly blocked scupper
D = 3		
Left DER-U 333-3		
Right DER-U 343-3		
	No drainage provided with standing water	Surfaced over scupper (only partly open)
D = 4		
Left DER-U 412-4		
Right DER-U 423-3		
	Inlet grid missing (pedestrian safety) (MS)	Spalling aggravated by deck drainage

**Bridge (General)**

<b>Item 10      Kerb/Sidewalk Defects</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Prestress duct is exposed. Section loss.	4
Lack of cover to reinforcement	There are sporadic signs of slight discolouration of concrete face indicating start of reinforcement corrosion due to lack of cover.	1
	There are clear signs of discolouration of concrete face along length of reinforcement bar with small cracks.	2
	Cracks are visible along the length of the reinforcement but with more significant cracks.	3
	Local spalling and extensive cracking and staining due to corrosion of reinforcement.	4
Sidewalk surface defects	Sidewalk surfacing, paving blocks or pre-cast planks are slightly uneven. Pedestrians may trip over uneven surface if they are not careful.	1
	Sidewalk surfacing, paving blocks or pre-cast planks are moderately uneven. Pedestrians will trip over uneven surface.	2
	Sidewalk surfacing, paving blocks or pre-cast planks has subsided or broken. Pedestrians have to walk around subsided areas or in the roadway	3
	Sidewalk surfacing, paving blocks or pre-cast planks, including manhole covers in surface are missing. Condition of sidewalk poses a hazard to pedestrians and may result in serious injury.	4

Item 10		Kerb/Sidewalk Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U 111-1			
	Spalling of kerb due to impact	Uneven pre-cast planks	
D = 2			
Left DER-U 231-2			
Right DER-U 222-1			
	Spalling on sidewalk due to lack of cover	Uneven pre-cast planks	
D = 3			
Left DER-U 322-2			
Right DER-U 323-4			
	Spalling on kerb due to lack of cover	Uneven and broken pre-cast planks	
D = 4			
Left DER-U 434-4			
Right DER-U 414-4			
	Failed concrete sidewalk	Manhole cover in sidewalk missing (MS)	









**Bridge (General)**

<b>Item 11 Parapet/Handrail Defects</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Prestress duct is exposed. Section loss.	4
Shrinkage and restraint cracks including AAR  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Collision damage	Damage is slight, concrete spalling is shallow, steel members are deformed but functional.	1
	Damage is moderate, concrete spalling is deep, steel members are deformed and broken, but parapet or handrail is still functional as a unit.	2
	Damage is major, concrete spalling is deep with reinforcement exposed, steel members are broken or missing, but parapet or handrail is still safe.	3
	Damage is severe, concrete members have failed or are missing, steel members are missing, parapet or handrail is not functional and not safe. "Make safe" action triggered.	4
Lack of cover to reinforcement	There are sporadic signs of slight discolouration of concrete face indicating start of reinforcement corrosion due to lack of cover.	1
	There are clear signs of discolouration of concrete face along length of reinforcement bar with small cracks.	2
	Cracks are visible along the length of the reinforcement but with more significant cracks.	3
	Local spalling and extensive cracking and staining due to corrosion of reinforcement.	4

Item 11		Parapet/Handrail Defect Photos		
D = 1			Collision damage to steel rail	Spalling due to constraint at expansion joint
Left DER-U 111-2				
Right DER-U 111-2				
D = 2			Collision damage at end block	Cracking due to corrosion of reinforcement
Left DER-U 212-3				
Right DER-U 232-2				
D = 3			Collision damage to parapet top rail	Crushing of bottom rail due to restraint
Left DER-U 322-2				
Right DER-U 323-3				
D = 4			Collision damage to handrail (MS)	Collision damage to parapet (MS)
Left DER-U 434-4				
Right DER-U 414-4				

**Bridge (General)**

<b>Item 12 Pier Protection Works Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Scour or erosion of pier founding material	Scour or erosion is shallow. There is no possibility of local collapse.	1
	Scour or erosion is shallow. Sides appear stable. There is a small possibility of local collapse.	3
	Scour or erosion is deep. There is a possibility of local collapse.	4
Guardrail protection of pier against vehicle impact	No guardrail protection provided, pier close to yellow line (<3m)	4
	No guardrail protection provided, pier not that close to yellow line (<7.5m)	2
	No guardrail protection provided, pier slender.	4
	Guardrail posts are cracked or broken.	1-2
	Guardrail posts are missing.	2-3
	Bolts/nuts are loose.	1-2
	Nuts are missing.	1-2
	Wood spacer blocks are misaligned.	1-2
	Wood spacer blocks are missing.	2-3
	Guardrails are damaged, bent or broken.	1-4
	Guardrails are corroded.	2-3
Laps need to be reversed.	3	

Item 12		Pier Protection Works Defect Photos	
D = 1			<p>Guardrail damaged</p> <p>Spall on pier protection</p>
Left DER-U 121-2			
Right DER-U 111-1			
D = 2			<p>Scour damage</p> <p>Accidental damage to guardrail</p>
Left DER-U 232-3			
Right DER-U 232-3			
D = 3			<p>Guardrail against and short of column</p> <p>Provide guardrail for pier protection</p>
Left DER-U 323-3			
Right DER-U 323-3			
D = 4			<p>Provide guardrail to protect slender pier</p> <p>Pier foundation piles exposed - protect</p>
Left DER-U 424-3			
Right DER-U 424-3			



**Bridge (General)**

<b>Item 13 Pier Foundation Defects</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Scour of foundations	Local scour at pier foundation is shallow. Scour has not exposed base of foundation.	1
	Local scour at pier foundation is shallow. Scour has partly exposed base of foundation or piles of piled foundation.	2
	Local scour at pier founded on piles has exposed the piles. Scour has exposed erodible founding material of a spread footing on a small portion of the perimeter of footing.	3
	Scour has exposed erodible founding material of a spread footing which might cause the footing to collapse or settle.	4
Shrinkage and restraint cracks including AAR  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Shear cracks  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is visible of the order of 0.1 to 0.2 mm and there are no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.2 mm but smaller or equal to 0.4 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is greater than 0.4 mm with no signs of water leakage or corrosion of reinforcement.	3
	Crack is greater than 0.5 mm and there are signs of water passing through crack and/or evidence of corrosion of reinforcement.	4
Honeycombing  (If possible, areas of honeycombed concrete must be removed to expose full extent of damage)	Honeycombing is shallow and reinforcement is not visible.	1
	Honeycombing is shallow. Reinforcement is partly exposed. No signs of corrosion.	2
	Reinforcement is fully exposed, with some signs of corrosion; or reinforcement is partly exposed and corroded. Prestress duct is partly exposed.	3
	Reinforcement is exposed and corroded. Prestress duct is exposed.	4
Bending cracks  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4

Item 13		Pier Foundation Defect Photos	
D = 1			
Left DER-U 121-2			
Right DER-U 111-2			
	Vertical crack in foundation beam	Local scour of pier foundation	
D = 2			
Left DER-U 222-2			
Right DER-U 222-2			
	Honeycombing in pier foundation	Cracks in top of pile cap	
D = 3			
Left DER-U 342-3			
Right DER-U 342-2			
	Scour of pier foundation	Scour of pier foundation	
D = 4			
Left DER-U 413-3			
Right DER-U 424-4			
	Scour of pier foundation	Shear crack in pier foundation	







**Bridge (General)**

<b>Item 14 Pier &amp; Column Defects</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Shrinkage and restraint cracks including AAR  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Prestress duct is exposed. Section loss.	4

Item 14		Pier & Column Defect Photos		
D = 1			Collision damage spalling on column	Horizontal crack in column
Left DER-U 111-2				
Right DER-U 111-2				
D = 2			Crack in pier nose	Spall on pier end
Left DER-U 211-2				
Right DER-U 211-3				
D = 3			AAR cracking in pier head	Crack in pier nose
Left DER-U 321-3				
Right DER-U 312-3				
D = 4			Spalling of pier nose	Spalling at column base
Left DER-U 413-4				
Right DER-U 413-4				

**Bridge (General)**

<b>Item 15 Bearing Defects</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Corrosion:	Light corrosion on steel components	1
	Corrosion is more extensive but no flaking	2
	Corrosion is flaking but not significantly inhibiting movement	3
	Corrosion has caused bearings to seize	4
Seals and gaiters:	These are slightly damaged	1
	These are extensively damaged, torn or missing	2
	Bearings have deteriorated due to missing or damaged gaiters	3
Debris:	There are birds' nests and other debris around the bearing	1
	Debris is causing damage such as corrosion	2
	Debris is causing significant damage to the bearing	3
Cracks and spalls:	There are shrinkage cracks in the plinths, etc.	1
	These are more extensive but do not compromise the bearing capacity	2
	Cracks and spalls in plinth is extending slightly under the bearing area	3
	These extend well under the bearing area, significantly reducing the capacity of the bearing	4
Elastomeric bearings:	Distortion is >30% of bearing height, minor cracks in the side of the bearings	2
	Distortion is >50% of height or edges are extensively cracked with bearing plates showing corrosion	3
	Distortion is >70% of height or plates have de-bonded with sliding occurring on the plates. Bearing has moved	4
Bearing movement:	Travel lugs or pre-set brackets have not been cut or removed but there is no consequential damage	2
	There is excessive movement at the limit of the bearing capacity	3
	Bearing movement is no longer occurring, compromising the safety of the structure	4
Sliding components:	PTFE sheeting, lead sheets or stainless steel plates are coming out or de-bonding but movement is still occurring	3
	Sliding components are beyond their working range compromising the safety of the bearing and structure	4

Item 15		Bearing Defect Photos	
D = 1			
Left DER-U 111-0			
Right DER-U 111-1			
	Bearing lightly corroded	Bird's nest next to bearing	
D = 2			
Left DER-U 211-2			
Right DER-U 211-0			
	Debris causing corrosion	Elastomeric bearing cracking	
D = 3			
Left DER-U 312-2			
Right DER-U 332-2			
	Elastomeric bearing extensively cracked	Extensive corrosion and flaking	
D = 4			
Left DER-U 424-4			
Right DER-U 433-3			
	Spalling due to bearing movement restraint	Corrosion has restrained movement	

**Bridge (General)**

<b>Item 16 Support Drainage Defects</b>		
<p>The main function of support drainage is to drain water away from the bearings. Ineffective or lack of support drainage will be visible as streaking and staining on the abutment walls.</p> <p>Pier tops should be shaped to drain water (from leaking expansion joints) away from the bearings and not cause ponding of water.</p>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Drain is partly silted up.	Water flow is restricted but drain is still functional.	1
Drain is in the order of 50% blocked.	Water flow is restricted.	2
Drain is almost completely blocked.	Water flow severely restricted and ponding water can cause damage to bearings.	3
Drain is completely blocked up or not installed as required.	No water flow can take place and bearings are damaged and not functioning as designed.	4

Item 16		Support Drainage Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U 121-2			
	Support drainage blocked	Support drainage not working properly	
D = 2			
Left DER-U 222-2			
Right DER-U 212-2			
	Support drainage channel blocked	Blocked support drainage	
D = 3			
Left DER-U 343-3			
Right DER-U 343-3			
	No support drainage installed	Loose sand and rocks in drainage channel	
D = 4			
Left DER-U 423-3			
Right DER-U 423-3			
	Severely rusted bearing	Severely rusted bearing	









**Bridge (General)**

<b>Item 17      Expansion Joint Defects</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Leaking:	Signs of some minor leaking but no consequential damage to bearings, concrete, steel, etc. below	1
	Signs of more extensive leaking but no damage to bearings, concrete, steel, etc. below	2
	Extensive signs of leaking with damage to bearings, concrete, steel, etc. below	3
	Extensive leaking has caused significant damage such as bearings seizing, extensive concrete spalling, prestressing anchors corroding, etc.	4
Safety:	Some slight spalling and cracking of the joint but no signs of it posing a danger to traffic	1
	Some spalling and cracking of the joint but does not pose a danger to traffic	2
	Parts of the nosing are coming loose but in small pieces. Claws and steel or aluminium components are no longer firmly fixed	3
	Parts of the nosing is coming loose in large pieces, claws and steel or aluminium components are loose, etc. any of which can pose a danger to traffic	4
Asphaltic plug joints:	Some deterioration such as some small cracks, slight rutting etc.	1
	More extensive deterioration such as some cracks, rutting etc.	2
	Large cracks, deep rutting, some loss of joint causing holes	3
	Deep rutting and large holes presenting a danger to traffic	4
Cover-plates:	Slight deterioration to cover plates	1
	More deterioration to cover plates, loose bolts, plates missing over small gaps less than 40 mm etc.	2
	Bolts missing, plates missing over gaps less than 150 mm, etc.	3
	Plates standing out at a dangerous angle, missing plates over large gaps, etc. any of which present a danger to traffic or pedestrians	4

Expansion joints that have closed due to abutment tilting must be recorded as an abutment defect.

On expansion joints which have opened beyond their design limits, record in terms of leaking and safety. In multi-element joints where longitudinal bearer beams are at the limit of their travel and may be coming off the bearing pads, record this as D=4.

For asphalt deterioration or damage adjacent to an expansion joint, record as a surfacing defect

Item 17		Expansion Joint Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U 111-R			
	Parapet plate missing – small gap	Shrinkage cracks in nosing	
D = 2			
Left DER-U 211-2			
Right DER-U 211-2			
	Parapet plate missing – large gap	Part of bolt-down EJ has come off	
D = 3			
Left DER-U 323-3			
Right DER-U 332-3			
		Deep rutting	
D = 4			
Left DER-U 424-4			
Right DER-U 424-4			
	Kerbstone loose – can cut tyre	Loose protruding plate in EJ	

**Bridge (General)**

<b>Item 18 Longitudinal Member Defects</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Prestress duct is exposed. Section loss.	4
Bending cracks  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Shear cracks  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is visible of the order of 0.1 to 0.2 mm and there are no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.2 mm but smaller or equal to 0.4 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is greater than 0.4 mm with no signs of water leakage or corrosion of reinforcement.	3
	Crack is greater than 0.5 mm and there are signs of water passing through crack and/or evidence of corrosion of reinforcement.	4
Shrinkage and restraint cracks including AAR  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Honeycombing  (If possible, areas of honeycombed concrete must be removed to expose full extent of damage)	Honeycombing is shallow and reinforcement is not visible.	1
	Honeycombing is shallow. Reinforcement is partly exposed. No signs of corrosion.	2
	Reinforcement is fully exposed, with some signs of corrosion; or reinforcement is partly exposed and corroded. Prestress duct is partly exposed.	3
	Reinforcement is exposed and corroded. Prestress duct is exposed.	4

Item 18		Longitudinal Member Defect Photos	
D = 1			
Left DER-U 121-2			
Right DER-U 111-2			
	Horizontal crack in beam	Spall on beam edge	
D = 2			
Left DER-U 212-3			
Right DER-U 222-3			
	Shear crack at haunch in beam	AAR cracking on beam	
D = 3			
Left DER-U 333-3			
Right DER-U 323-4			
	Honeycombing in beam web	Spalling on beam soffit	
D = 4			
Left DER-U 414-4			
Right DER-U 414-4			
	Collision spalling of beam soffit	Collision spalling on beam soffit	

## Bridge (General)









Item 19 Transverse Member Defects		
Defects	Observations	D
Honeycombing  (If possible, areas of honeycombed concrete must be removed to expose full extent of damage)	Honeycombing is shallow and reinforcement is not visible.	1
	Honeycombing is shallow. Reinforcement is partly exposed. No signs of corrosion.	2
	Reinforcement is fully exposed, with some signs of corrosion; or reinforcement is partly exposed and corroded. Prestress duct is partly exposed.	3
	Reinforcement is exposed and corroded. Prestress duct is exposed.	4
Shrinkage and restraint cracks including AAR  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Prestress duct is exposed. Section loss.	4
Lack of cover to reinforcement	There are sporadic signs of slight discolouration of concrete face indicating start of reinforcement corrosion due to lack of cover.	1
	There are clear signs of discolouration of concrete face along length of reinforcement bar with small cracks.	2
	Cracks are visible along the length of the reinforcement but with more significant cracks.	3
	Local spalling and extensive cracking and staining due to corrosion of reinforcement.	4

Item 19		Transverse Member Defect Photos	
D = 1			
Left DER-U 121-2			
Right DER-U 111-2			
	Honeycombing in diaphragm beam	Vertical crack in diaphragm beam	
D = 2			
Left DER-U 232-3			
Right DER-U 211-2			
	Spalling due to lack of cover	Vertical crack in diaphragm beam	
D = 3			
Left DER-U 333-3			
Right DER-U 333-3			
	Spalling due to lack of cover	Spalling of diaphragm beam	
D = 4			
Left DER-U 423-4			
Right DER-U 424-4			
	Restraint crack in diaphragm beam	Restraint crack in diaphragm beam	

## Bridge (General)








Item 20 Deck & Slab Defects		
Defects	Observations	D
Bending cracks  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Shear cracks  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is visible of the order of 0.1 to 0.2 mm and there are no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.2 mm but smaller or equal to 0.4 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is greater than 0.4 mm with no signs of water leakage or corrosion of reinforcement.	3
	Crack is greater than 0.5 mm and there are signs of water passing through crack and/or evidence of corrosion of reinforcement.	4
Lack of cover to reinforcement	There are sporadic signs of slight discolouration of concrete face indicating start of reinforcement corrosion due to lack of cover.	1
	There are clear signs of discolouration of concrete face along length of reinforcement bar with small cracks.	2
	Cracks are visible along the length of the reinforcement but with more significant cracks.	3
	Local spalling and extensive cracking and staining due to corrosion of reinforcement.	4
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Prestress duct is exposed. Section loss.	4

**Item 20: Deck & Slab Defect Photos**

D = 1		
Left DER-U 121-2		
Right DER-U 111-2		
	Vertical cracks in deck side	Collision spalling on deck edge
D = 2		
Left DER-U 221-2		
Right DER-U 212-2		
	Bending crack in deck	Spalling on deck due to lack of cover
D = 3		
Left DER-U 312-3		
Right DER-U 322-3		
	Horizontal crack in deck	Spalling due to lack of cover
D = 4		
Left DER-U 422-3		
Right DER-U 413-4		
	Horizontal crack in deck edge	Collision spalling in box girder soffit

## Bridge (General)

Item 21 Miscellaneous Items Defects				
Defects	Observations: Relevancy	R	Observations: Degree	D
Cover slabs, manhole covers, lids, etc.	Smaller covers missing or broken, not creating a hazard	1	Covers are slightly damaged	1
	Larger covers missing or broken, not creating a hazard	2	Covers are missing	4
	Covers missing, creating a hazard for vehicles or pedestrians but not in direct path of vehicles or pedestrians	3		
	Large covers missing, creating an immediate hazard for vehicles or pedestrians	4		
Access chamber doors, gallery doors, access holes to deck soffit - missing or damaged:	Posing no danger, no access to an habitable area	1	Doors are slightly damaged	1
	Potentially dangerous or posing a risk to the structure	3	Doors are missing	4
	Dangerous, or people living inside structure and lighting fires, damaging the structure, etc.	4		
People living in structure:	Small group of people with no erected structures	1	Small group of people with no erected structures	1
	Larger group of people with structures but not posing any risk	2	Dense habitation	4
	Habitation causing obstructions or, fire or safety risk	3		
	Dense habitation creating a high fire or safety risk	4		
Vertical clearance signs:	No signs with vertical clearance less than 5.0 m	1	Signs are slightly damaged	1
	No signs with vertical clearance less than 4.9 m	2	Signs are missing	4
	No signs with vertical clearance less than 4.8 m	3		
	No signs with vertical clearance less than 4.8 m with beam-and-slab deck	4		
Road signs – missing or damaged:	River name, information signs	1	Signs are slightly damaged	1
	Warning signs, hazard signs but not posing a safety risk	3	Signs are missing	4
	Warning signs, hazard signs posing a safety risk	4		
Services and street lighting:	Services not attached properly, missing cover plates but not posing a risk	1	Service attachments/cover plates slightly damaged	1
	Missing cover plates exposing wiring, damaged lighting posing some difficulty to pedestrians, etc.	2	Service attachments/cover plates missing	4
	Exposed live wires, leaking sewerage, etc.	3		
Fencing – missing or damaged:	Small holes, posing no danger	1	Small holes	1
	Posing a significant danger such as livestock getting onto the road or pedestrians crossing an extremely busy road	4	Fencing missing	4
Structure number plate:	Relevancy would always be 1	1	Damaged structure number plate	1/2
			Missing structure number plate	4
Animal infestation including bats, bees, wasps, snakes, etc.	Slight infestation, not posing a risk to people or the structure	1	Slight infestation	1
	Dangerous infestation or causing damage to the structure such as guano causing corrosion	3	Extensive infestation	4

Item 21		Miscellaneous Items Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U 111-2			
	People living under bridge	Missing service duct cover – no services	
D = 2			
Left DER-U 212-2			
Right DER-U 212-3			
	Bridge with vertical clearance < 4.9 m	Hole in wall to gallery	
D = 3			
Left DER-U			
Right DER-U 313-4			
		People making fires under deck	
D = 4			
Left DER-U 413-4			
Right DER-U 414-4			
	Missing drainage cover next to road (MS)	Missing manhole cover on sidewalk (MS)	









## 2.2 Bridge (Cellular) and Major Culvert

Item 1 Apron Slab and Cut Off Wall Defects		
Defects	Observations	D
Shrinkage and restraint cracks including AAR  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Scour of outlet structures	Local scour at outlet is shallow. Scour has not exposed base of cut off wall or apron slab.	1
	Local scour at outlet is shallow. Scour has partly exposed base of cut off wall or apron slab.	2
	Local scour at outlet has exposed cut off wall or apron slab. Scour has exposed erodible founding material of outlet structures and some structural damage of cut off wall or apron slab has occurred.	3
	Scour has exposed erodible founding material of outlet structures. Severe structural damage has occurred. Further scour may cause collapse of culvert.	4

Item 1		Apron Slab and Cut Off Wall Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U 121-2			
	Crack in apron slab	Cracks in apron slab	
D = 2			
Left DER-U 222-2			
Right DER-U 222-2			
	Crack in apron slab	Settlement at joint in apron slab	
D = 3			
Left DER-U 322-2			
Right DER-U 332-3			
	Crack in apron slab	Crack between apron slab and cut off wall	
D = 4			
Left DER-U 423-4			
Right DER-U 444-4			
	Scour below apron slab at outlet	Severe scour damage at outlet	









## Bridge (Cellular) and Major Culvert

Item 2 Wing, Return, Head Wall Defects		
Defects	Observations	D
Shrinkage and restraint cracks including AAR  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Lack of cover to reinforcement	There are sporadic signs of slight discolouration of concrete face indicating start of reinforcement corrosion due to lack of cover.	1
	There are clear signs of discolouration of concrete face along length of reinforcement bar with small cracks.	2
	Cracks are visible along the length of the reinforcement but with more significant cracks.	3
	Local spalling and extensive cracking and staining due to corrosion of reinforcement.	4
Rotation/leaning of wing walls	Marginal, but visible leaning of the wall. Differential displacement at top of wall at joint with abutment, cellular structure or other section of wall is in the order of height / 200 or between 20 mm and 30 mm.	1
	Moderate leaning of the wall. Differential displacement at top of wall at joint with abutment, cellular structure or other section of wall is in the order of height / 150 or between 30 mm and 40mm.	2
	Significant leaning of the wall. Differential displacement at top of wall at joint with abutment, cellular structure or other section of wall is in the order of height / 100 or between 40 mm and 50 mm.	3
	Severe leaning of the wall. There is a large gap between the wall and adjacent structure. Differential displacement at top of wall at joint with abutment, cellular structure or other section of wall is larger than height / 100 or 50 mm.	4

Item 2		Wing, Return, Head Wall Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U 111-2			
	Diagonal crack in wing wall	Spalling on head wall	
D = 2			
Left DER-U 212-2			
Right DER-U 222-2			
	Diagonal crack in wing wall	Wing wall leaning over	
D = 3			
Left DER-U 322-2			
Right DER-U 333-3			
	Diagonal crack in wing wall	Spalling on head wall due to lack of cover	
D = 4			
Left DER-U 414-4			
Right DER-U 434-4			
	Rotation of wing wall	Diagonal crack in wing wall	









### Bridge (Cellular) and Major Culvert

Item 3 Scour Protection Works (In Waterway) Defects		
Defect	Observations	D
Scour or erosion of waterway	Scour or erosion is shallow. There is no possibility of local collapse.	1
	Scour or erosion is shallow. Sides appear stable. There is a small possibility of local collapse.	2
	Scour or erosion is deep. There is a possibility of local collapse.	3
	Scour or erosion is deep. Sides are vertical or overhanging. Sides appear unstable. There is a real possibility of local collapse, which would endanger the roadway.	4
Flood debris accumulation	Loose debris accumulating on piers or bridge decks.	1
	Debris accumulation in the form of small branches on piers or on bridge decks.	2
	Debris accumulation in the form of large branches or small trees on piers or on bridge decks.	3
	Debris accumulation in the form of large trees on piers or on bridge decks.	4
	Siltation significantly reducing capacity of floods at bridge.	2-4
Defective scour protection works.	<p>Scour protection materials can comprise:-</p> <ul style="list-style-type: none"> <li>• Gabion mattresses and/or boxes</li> <li>• Stone pitching</li> <li>• Grouted stone pitching</li> <li>• Interlocking concrete paving blocks</li> <li>• Concrete slabs</li> <li>• Precast concrete retaining blocks</li> <li>• Geocells</li> <li>• Vegetation</li> <li>• Interlocking cellular concrete grass blocks</li> </ul> <p>General defects include:-</p> <p>Vegetation within the protection works to a lesser or larger degree can cause damage to the protection works and is aesthetically a problem.</p> <p>Portions of the protection works are missing; they may have been removed by vandals or have eroded away.</p> <p>Protection works were never provided or have been completely removed. In river bridges the abutment stability may be compromised.</p>	<p>1-3</p> <p>2-3</p> <p>3-4</p>

Item 3		Scour Protection Works (In Waterway) Defect Photos	
D = 1			
Left DER-U 121-2			
Right DER-U 111-3			
	Embankment Erosion	Upstream precast concrete blocks broken	
D = 2			
Left DER-U 221-2			
Right DER-U 222-2			
	Outlet scour under apron slab	Outlet scour shifting gabions	
D = 3			
Left DER-U 332-2			
Right DER-U 331-1			
	Failed gabions at outlet	Erosion at outlet	
D = 4			
Left DER-U 433-4			
Right DER-U 433-4			
	Apron slab washed away	Apron slab severely damaged	









**Bridge (Cellular) and Major Culvert**

<b>Item 4      Embankment Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Scour or erosion of embankment	Scour or erosion is shallow. There is no possibility of local collapse.	1
	Scour or erosion is shallow. Sides appear stable. There is a small possibility of local collapse.	2
	Scour or erosion is deep. There is a possibility of local collapse.	3
	Scour or erosion is deep. Sides are vertical or overhanging. Sides appear unstable. There is a real possibility of local collapse, which would endanger the roadway.	4
Kerbs, berms and/or down chutes	Kerbs, berms or down chutes are ineffective due to the collection of debris and/or vegetation or due to minor damage.	1
	Kerbs, berms or down chutes are moderately damaged.	2
	The damage on kerbs, berms or down chutes has reached a warning state.	3
	Kerbs, berms or down chutes are severely damaged.	4
Trees and vegetation	Trees and vegetation can be detrimental to the integrity of the approach embankment as well as contribute to reduced site distances etc.	
	Minor	1
	Moderate	2
	Warning	3
	Severe	4

Item 4		Embankment Defect Photos	
D = 1			
Left DER-U 121-2			
Right DER-U 121-2			
	Embankment Erosion	Erosion behind wing wall	
D = 2			
Left DER-U 221-2			
Right DER-U 222-2			
	Embankment Erosion	Erosion behind wing wall	
D = 3			
Left DER-U 323-3			
Right DER-U 311-2			
	Fill on culvert eroded away	Embankment Erosion	
D = 4			
Left DER-U 422-3			
Right DER-U 433-4			
	Embankment Erosion	Existing stone pitching damaged through floods	








## Bridge (Cellular) and Major Culvert

Item 5 Waterway Defects		
Defect	Observations	D
Flood debris accumulation	Loose debris accumulating in culvert.	1
	Debris accumulation in the form of small branches in the culvert.	2
	Debris accumulation in the form of large branches or small trees in the culvert.	3
	Debris accumulation in the form of large trees in the culvert.	4
Siltation	Siltation reduces the flood capacity of the culvert	
	Moderate	2
	Warning	3
	Severe	4
Vegetation growth within the waterway	Reeds, bushes and trees growing within the culvert waterway reducing the flood capacity of the culvert.	
	Minor (Reeds and bushes)	1
	Moderate (Reeds and bushes)	2
	Warning (Bushes and trees)	3
	Severe (Bushes and trees)	4

Item 5		Waterway Defect Photos	
D = 1			Waterway blocked
Left DER-U 111-2			
Right DER-U 121-2			
D = 2			Waterway blocked
Left DER-U 232-3			
Right DER-U 222-3			
D = 3			Culvert cell silted up
Left DER-U 323-3			
Right DER-U 322-3			
D = 4			Culvert cells clogged with sand
Left DER-U 433-4			
Right DER-U 433-3			
	All culvert cells clogged with sand		


**Bridge (Cellular) and Major Culvert**

<b>Item 6 Road Slab Defects</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Cracking  Cracks can be transverse, longitudinal or corner cracks.	Cracks are narrow, not clearly visible and without spalling.	1
	Cracks are wider, clearly visible with some minor spalling.	2
	Cracks are wider, clearly visible with some moderate spalling	3
	Cracks are very wide, clearly visible and with serious spalling.	4
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Section loss.	4

Item 6		Road Slab Defect Photos		
D = 1				
Left DER-U 111-2				
Right DER-U				
	Crack in road slab			
D = 2				
Left DER-U 222-2				
Right DER-U 222-2				
	Abrasion damage to road slab	Crack in road slab		
D = 3				
Left DER-U 332-3				
Right DER-U 322-3				
	Road slab cracking	Broken road slab		
D = 4				
Left DER-U 433-4				
Right DER-U 442-3				
	Road slab breaking up	Road slab cracking		









**Bridge (Cellular) and Major Culvert**

<b>Item 7 Roadway Joint Defects</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Defective roadway joints	Crack developing between joint and adjoining concrete surfacing.	1
	Minor cracking in concrete next to roadway joint; or accumulation of debris in joint impairing its proper functioning	2
	Major cracking in concrete next to roadway joint.	3
	Severe cracking and spalling in concrete next to roadway joint.	4

Item 7		Roadway Joint Defect Photos	
D = 1			
Left DER-U 121-2			
Right DER-U 121-1			
	Joint to be sealed	Grass in roadway joint	
D = 2			
Left DER-U 212-2			
Right DER-U 343-1			
	Cracking at roadway joint	Joint filled with sand	
D = 3			
Left DER-U 332-3			
Right DER-U			
	Spalling at roadway joint		
D = 4			
Left DER-U 443-4			
Right DER-U			
	Spalling at joint		

**Bridge (Cellular) and Major Culvert**

<b>Item 8 Guardrail Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Defective guardrail	Guardrail posts are cracked or broken.	1-2
	Guardrail posts are missing.	2-3
	Bolts/nuts are loose.	1-2
	Nuts are missing.	1-2
	Wood spacer blocks are misaligned.	1-2
	Wood spacer blocks are missing.	2-3
	Guardrails are damaged, bent or broken.	1-4
	Guardrails are corroded.	2-3
	Laps need to be reversed.	3

Item 8		Guardrail Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U 111-2			
	Guardrail post rotten and weathered	Guardrail post cracked	
D = 2			
Left DER-U 211-3			
Right DER-U 222-3			
	Guardrail damaged by collision	Guardrail damaged by collision	
D = 3			
Left DER-U 313-3			
Right DER-U 322-3			
	Guardrail not attached to end block	Guardrail damaged by collision	
D = 4			
Left DER-U 423.4			
Right DER-U 442-3			
	Guardrail damaged by collision (MS)	No Guardrails	

## Bridge (Cellular) and Major Culvert

Item 9 Parapet/Handrail Defects		
Defects	Observations	D
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Prestress duct is exposed. Section loss.	4
Shrinkage and restraint cracks including AAR  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Collision damage	Damage is slight, concrete spalling is shallow, steel members are deformed but functional.	1
	Damage is moderate, concrete spalling is deep, steel members are deformed and broken, but parapet or handrail is still functional as a unit.	2
	Damage is major, concrete spalling is deep with reinforcement exposed, steel members are broken or missing, but parapet or handrail is still safe.	3
	Damage is severe, concrete members have failed or are missing, steel members are missing, parapet or handrail is not functional and not safe. "Make safe" action triggered.	4
Lack of cover to reinforcement	There are sporadic signs of slight discolouration of concrete face indicating start of reinforcement corrosion due to lack of cover.	1
	There are clear signs of discolouration of concrete face along length of reinforcement bar with small cracks.	2
	Cracks are visible along the length of the reinforcement but with more significant cracks.	3
	Local spalling and extensive cracking and staining due to corrosion of reinforcement.	4

Item 9 Parapet/Handrail Defect Photos		
D = 1		
Left DER-U 111-3		
Right DER-U 141-2		
	Parapet wall damaged/ reinforcing exposed	Surface corrosion on steel handrail
D = 2		
Left DER-U 212-3		
Right DER-U 222-2		
	Collision damage at end block	Spalling due to corrosion of reinforcement
D = 3		
Left DER-U 324-4		
Right DER-U 332-3		
	Collision damage to handrail and end block	Damaged steel handrail
D = 4		
Left DER-U 424-4		
Right DER-U 414-4		
	Collision damage to parapet	Collision damage to handrail (MS)


## Bridge (Cellular) and Major Culvert

Item 10 Wall Defects		
Defects	Observations	D
Shrinkage and restraint cracks including AAR  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Lack of cover to reinforcement	There are sporadic signs of slight discolouration of concrete face indicating start of reinforcement corrosion due to lack of cover.	1
	There are clear signs of discolouration of concrete face along length of reinforcement bar with small cracks.	2
	Cracks are visible along the length of the reinforcement but with more significant cracks.	3
	Local spalling and extensive cracking and staining due to corrosion of reinforcement.	4
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Prestress duct is exposed. Section loss.	4
Honeycombing  (If possible, areas of honeycombed concrete must be removed to expose full extent of damage)	Honeycombing is shallow and reinforcement is not visible.	1
	Honeycombing is shallow. Reinforcement is partly exposed. No signs of corrosion.	2
	Reinforcement is fully exposed, with some signs of corrosion; or reinforcement is partly exposed and corroded. Prestress duct is partly exposed.	3
	Reinforcement is exposed and corroded. Prestress duct is exposed. .	4
General concrete deterioration due to aggressive water attack or erosion	Loss of surface mortar and shallow exposure of large aggregate.	1
	Deep erosion of fines and loss of large aggregate in places but without exposure of reinforcement.	2
	Loss of large aggregate, exposure of reinforcement with moderate corrosion.	3
	Severe section loss and significant corrosion of reinforcement.	4

Item 10		Wall Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U 121-2			
	Crack in culvert wall	Honeycombing in culvert wall	
D = 2			
Left DER-U 211-2			
Right DER-U 212-2			
	Spalling on culvert wall ends due to impact	Spalling due to lack of cover	
D = 3			
Left DER-U 322-3			
Right DER-U 312-3			
	Vertical crack in culvert wall	Spalling due to corrosion of reinforcement	
D = 4			
Left DER-U 434-4			
Right DER-U 434-3			
	Vertical crack in culvert wall	Concrete deterioration and cracking	

## Bridge (Cellular) and Major Culvert

Item 11 Top Slab Defects		
Defects	Observations	D
Honeycombing  (If possible, areas of honeycombed concrete must be removed to expose full extent of damage)	Honeycombing is shallow and reinforcement is not visible.	1
	Honeycombing is shallow. Reinforcement is partly exposed. No signs of corrosion.	2
	Reinforcement is fully exposed, with some signs of corrosion; or reinforcement is partly exposed and corroded. Prestress duct is partly exposed.	3
	Reinforcement is exposed and corroded. Prestress duct is exposed.	4
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem.	3
	Reinforcement is exposed and significantly corroded. Prestress duct is exposed. Section loss.	4
Lack of cover to reinforcement	There are sporadic signs of slight discolouration of concrete face indicating start of reinforcement corrosion due to lack of cover.	1
	There are clear signs of discolouration of concrete face along length of reinforcement bar with small cracks.	2
	Cracks are visible along the length of the reinforcement but with more significant cracks.	3
	Local spalling and extensive cracking and staining due to corrosion of reinforcement.	4
Shear cracks  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is visible of the order of 0.1 to 0.2 mm and there are no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.2 mm but smaller or equal to 0.4 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is greater than 0.4 mm with no signs of water leakage or corrosion of reinforcement.	3
	Crack is greater than 0.5 mm and there are signs of water passing through crack and/or evidence of corrosion of reinforcement.	4

Item 11		Top Slab Defect Photos	
D = 1			
Left DER-U 111-1			
Right DER-U 111-1			
	Marginal honeycombing in slab	Minor spalling due to collision damage	
D = 2			
Left DER-U 222-2			
Right DER-U 212-2			
	Moderate honeycombing in slab	Moderate spalling due to restraint at joint	
D = 3			
Left DER-U 323-3			
Right DER-U 323-3			
	Significant honeycombing	Significant spalling due to lack of cover	
D = 4			
Left DER-U 414-4			
Right DER-U 424-4			
	Severe shear cracks due to collision damage	Severe corrosion due to honeycombing	








## Bridge (Cellular) and Major Culvert

Item 12      Invert Slab Defects		
Defects	Observations	D
Bending cracks  (Crack should be cleaned. Its width and if possible its depth ascertained)	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Lack of cover to reinforcement	There are sporadic signs of slight discolouration of concrete face indicating start of reinforcement corrosion due to lack of cover.	1
	There are clear signs of discolouration of concrete face along length of reinforcement bar with small cracks.	2
	Cracks are visible along the length of the reinforcement but with more significant cracks.	3
	Local spalling and extensive cracking and staining due to corrosion of reinforcement.	4
Spalling  (All loose concrete must be broken away to expose extent of spall)	Spalling is shallow and reinforcement is not visible.	1
	Spalling is shallow. Reinforcement is partly exposed. Minor signs of corrosion. Thus spalling not attributable to corrosion.	2
	Reinforcement is partially or fully exposed and corrosion is a problem	3
	Reinforcement is exposed and significantly corroded. Prestress duct is exposed. Section loss.	4
Corrugated metal culvert barrels corrosion	Marginal rust no pitting or section loss	1
	Moderate rust with pitting but no section loss	2
	Significant rust and deep pitting with section loss but no perforations	3
	Severe rust with perforations and evidence of piping	4
General concrete deterioration due to aggressive water attack or erosion	Loss of surface mortar and shallow exposure of large aggregate	1
	Deep erosion of fines and loss of large aggregate in places but without exposure of reinforcement	2
	Loss of large aggregate, exposure of reinforcement with moderate corrosion	3
	Severe section loss and significant corrosion of reinforcement	4

Item 12		Invert Slab Defect Photos			
D = 1			<p>Left DER-U 111-1</p> <p>Right DER-U 141-2</p>		
				Longitudinal crack in invert slab	Concrete surface deterioration of invert slab
D = 2			<p>Left DER-U 211-2</p> <p>Right DER-U 232-3</p>		
				Longitudinal crack in invert slab	Corrosion of corrugated metal culvert
D = 3			<p>Left DER-U 333-3</p> <p>Right DER-U 322-3</p>		
				Longitudinal crack in invert slab	Spalling due to erosion damage to invert slab
D = 4			<p>Left DER-U 444-4</p> <p>Right DER-U 443-3</p>		
				Corrosion of metal culvert	Spalling due to lack of cover







**Bridge (Cellular) and Major Culvert**

<b>Item 13      Cell Displacement</b>		
<b>Defects</b>	<b>Observations</b>	<b>D</b>
Cell displacement or rotation	Minor displacement that probably occurred during construction	1
	Moderate displacement with small opening of joints, showing some signs of leaking	2
	Larger displacement or rotation of cells with loss of fill through the joints	3
	Cells displaced or rotated to such an extent that units have separated	4
	Armco pipe or arch culverts severely deformed	4

Item 13		Cell Displacement Photos	
D = 1			<p>Displacement of cell and leaking joints</p> <p>Displacement of cell (probably during construction)</p>
Left DER-U 122-2			
Right DER-U 111-2			
D = 2			<p>Deformed Armco pipe</p> <p>Displaced top slab</p>
Left DER-U 242-3			
Right DER-U 222-3			
D = 3			<p>Settlement of cells</p> <p>Settlement of cells</p>
Left DER-U 332-2			
Right DER-U 323-3			
D = 4			<p>Displacement of cells due to erosion</p>
Left DER-U 434-4			
Right DER-U			








## 2.3 Retaining Wall

Item 1 External Drainage Defects		
Defect	Observations	D
Kerbs, berms at road level and/or channels behind walls are defective.	Kerbs, berms or channels are ineffective due to the collection of debris and/or vegetation or due to minor damage.	1
	Kerbs, berms or channels are moderately damaged.	2
	The damage on kerbs, berms or channels has reached a warning state.	3
	Kerbs, berms or channels are severely damaged.	4
No stormwater channels have been provided behind the wall.	Minor runoff over the wall.	1
	Moderate runoff over the wall.	2
	Runoff over the wall has reached warning levels.	3
	Severe runoff over the wall.	4

Item 1		External Drainage Defect Photos	
D = 1			
Left DER-U 121-2			
Right DER-U 111-2			
	Storm water runs over wall	Wall is stained	
D = 2			
Left DER-U 232-2			
Right DER-U 222-3			
	Storm water runs over wall		
D = 3			
Left DER-U 333-1			
Right DER-U 332-1			
	Ext drainage blocked by vegetation	Material behind wall	
D = 4			
Left DER-U			
Right DER-U			








## Retaining Walls

Item 2 Slope Protection Defects		
Defect	Observations	D
Defective slope protection works.	<p>Slope protection materials can comprise:-</p> <ul style="list-style-type: none"> <li>• Gabion mattresses and/or boxes</li> <li>• Stone pitching</li> <li>• Grouted stone pitching</li> <li>• Interlocking concrete paving blocks</li> <li>• Concrete slabs</li> <li>• Precast concrete retaining blocks</li> <li>• Geocells</li> <li>• Interlocking cellular concrete grass blocks</li> </ul> <p>General defects include:-</p>	
	Vegetation to a lesser or larger degree, which can cause damage to the protection works and is aesthetically a problem.	1-3
	Portions of the protection works are missing; they may have been removed by vandals or have eroded away.	2-3
	Protection works were never provided or have been completely removed. In river bridges the abutment stability may be compromised.	3-4
Scour or erosion of embankment	Scour or erosion is shallow. There is no possibility of local collapse.	1
	Scour or erosion is shallow. Sides appear stable. There is a small possibility of local collapse.	2
	Scour or erosion is deep. There is a possibility of local collapse.	3
	Scour or erosion is deep. Sides are vertical or overhanging. Sides appear unstable. There is a real possibility of local collapse, which would endanger the roadway.	4
Trees and vegetation	Trees and vegetation can be detrimental to the integrity of the approach embankment as well as contribute to reduced site distances etc.	
	Minor	1
	Moderate	2
	Warning	3
	Severe	4

<b>Item 2: Slope Protection Defect Photos</b>		
D = 1		
Left DER-U 111-0		
Right DER-U 132-2		
	Slope erosion	Repair cracks
D = 2		
Left DER-U 222-2		
Right DER-U 242-1		
	Gabion failure	Clear bush
D = 3		
Left DER-U 312-1		
Right DER-U		
	Replace netting.	
D = 4		
Left DER-U 443-3		
Right DER-U 423-4		
	Slope failure at wall. Damage due to rocks	Slope failure behind wall. Boulder damage.







## Retaining Walls

Item 3 Wall Defects		
Defect	Observations	D
Spalls and Honeycombing	Spalls and honeycombing is shallow and reinforcement is not visible.	1
	Spalls and honeycombing is shallow. Reinforcement is partly exposed. No signs of corrosion.	2
	Reinforcement is fully exposed, with some signs of corrosion; or reinforcement is partly exposed and corroded.	3
	Reinforcement is exposed and corroded.	4
Concrete cracks	Crack is of the order of 0.3 mm with no signs of water leakage or corrosion of reinforcement.	1
	Crack is greater than 0.3 mm but smaller or equal to 0.6 mm with no signs of water leakage or corrosion of reinforcement.	2
	Crack is of the order of 0.6 mm and there are signs of water passing through crack and evidence of corrosion of reinforcement.	3
	Crack is greater than 0.6 mm	4
Lack of cover to reinforcement	There are sporadic signs of slight discolouration of concrete face indicating start of reinforcement corrosion due to lack of cover.	1
	There are clear signs of discolouration of concrete face along length of reinforcement bar with small cracks.	2
	Cracks are visible along the length of the reinforcement but with more significant cracks.	3
	Local spalling and extensive cracking and staining due to corrosion of reinforcement.	4
Concrete staining	Stained concrete surfaces – minor, moderate.	1
	Stained concrete surfaces – warning, severe.	2-3

Item 3		Wall Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U 131-2			
	Panel cracking	Cracks in concrete	
D = 2			
Left DER-U 232-3			
Right DER-U 211-1			
	Concrete spalls, inadequate cover to rebar	Spalled concrete	
D = 3			
Left DER-U 333-3			
Right DER-U 313-3			
	Concrete spalling, inadequate cover to rebar	Damaged concrete at top of wall	
D = 4			
Left DER-U 444-4			
Right DER-U			
	Wall failure - reconstruct		


## Retaining Walls

Item 4 Joint Defects		
Defect	Observations	D
Defective expansion joints	Crack developing between joint and adjoining surfacing.	1
	Spall in concrete adjacent to joint, accumulation of debris in joint impairing its proper functioning	2
	Seal loose	3
	Seal missing	4

<b>Item 4: Joint Defect Photos</b>		
D = 1		
Left DER-U 121-1		
Right DER-U 121-2		
	Sealant starting to fail	Sealant starting to fail
D = 2		
Left DER-U 242-2		
Right DER-U 222-2		
	Vegetation in joints	Joint sealant failure
D = 3		
Left DER-U 313-3		
Right DER-U 323-2		
	Bushes growing from joint	Sealants have been removed
D = 4		
Left DER-U		
Right DER-U		







## Retaining Walls

Item 5 Internal Drainage Defects		
Defect	Observations	D
Subsurface drainage not working	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Subsurface drainage system not provided.  Stability problems could be expected if water build up occurs	Minor	1
	Moderate	2
	Warning	3
	Severe	4

Item 5		Internal Drainage Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U			
	No sign of subsurface drainage taking place		
D = 2			
Left DER-U			
Right DER-U			
D = 3			
Left DER-U			
Right DER-U			
D = 4			
Left DER-U			
Right DER-U			









## Retaining Walls

Item 6 Foundation Defects		
Defect	Observations	D
Wall movements and or rotations	Minor – note.	1
	Moderate – monitor.	2
	Warning – provide anchors.	3
	Severe – reconstruct.	4



Item 6		Foundation Defect Photos	
D = 1			
Left DER-U 121-1			
Right DER-U 121-2			
	Minor wall foundation rotation - note	Minor wall foundation rotation note	
D = 2			
Left DER-U 222-2			
Right DER-U 222-2			
	Moderate wall foundation rotation - monitor	Moderate wall foundation rotation - monitor	
D = 3			
Left DER-U 333-3			
Right DER-U			
	Wall foundation rotation in warning state - anchor		
D = 4			
Left DER-U 423-3			
Right DER-U			
	Severe wall foundation rotation - reconstruct		

## 2.4 Gantry

<b>Item 1 Guardrail Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Defective guardrail	Guardrail posts are cracked or broken.	1-2
	Guardrail posts are missing.	2-3
	Bolts/nuts are loose.	1-2
	Nuts are missing.	1-2
	Wood spacer blocks are misaligned.	1-2
	Wood spacer blocks are missing.	2-3
	Guardrails are damaged, bent or broken.	1-4
	Guardrails are corroded.	2-3
	Laps need to be reversed.	3

Item 1		Guardrail Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U 111-2			
	Guardrail post rotten and weathered	Guardrail post cracked	
D = 2			
Left DER-U 211-3			
Right DER-U 222-3			
	Guardrail damaged by collision	Guardrail damaged by collision	
D = 3			
Left DER-U 311-1			
Right DER-U 322-3			
	Post spacer rotting	Guardrail damaged by collision	
D = 4			
Left DER-U 422-3			
Right DER-U 423-4			
	Posts rotted and broken	Guardrail damaged by collision (MS)	

<b>Item 2 Foundation Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Concrete Defects	Spalls and honeycombing	1-4
	Lack of cover to reinforcement	1-3
	Concrete cracks	1-3
Scour and erosion defects	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Structure number	Missing or illegible number	2
Foundation rotations	Minor to moderate	3
	Warning to severe	4

Item 2		Foundation Defect Photos	
D = 1			
Left DER-U 121-1			
Right DER-U			
	Scour around foundation plinth		
D = 2			
Left DER-U 221-3			
Right DER-U			
	Minor cracks		
D = 3			
Left DER-U			
Right DER-U			
D = 4			
Left DER-U			
Right DER-U			

**Gantries**

<b>Item 3 HD Bolts and Base Plate Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Corrosion protection failure	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Missing/damaged bolts and nuts	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Base plate failure – requiring strengthening	Minor	1
	Moderate	2
	Warning	3
	Severe	4

Item 3		HD Bolts and Base Plate Defect Photos	
D = 1			Minor corrosion
Left DER-U 121-2			
Right DER-U 121-1			
D = 2			Moderate corrosion
Left DER-U 223-3			
Right DER-U 212-3			
D = 3			Corrosion in warning state and missing nuts
Left DER-U 333-3			
Right DER-U 323-3			
D = 4			Two out of five missing nuts
Left DER-U 434-4			
Right DER-U 423-4			







**Gantries**

<b>Item 4 Vertical Member Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Steel corrosion	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Damaged steel column	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Missing bolts	Minor	1
	Moderate	2
	Warning	3
	Severe	4

Item 4		Vertical Member Defect Photos	
D = 1			Minor corrosion
Left DER-U 111-1			
Right DER-U 121-3			
D = 2			Backing plate corroded, internal corrosion
Left DER-U 222-3			
Right DER-U 222-3			
D = 3			Weld failure possibly due to fatigue
Left DER-U 323-3			
Right DER-U 313-3			
D = 4			
Left DER-U 413-3			
Right DER-U			
	Severe corrosion		








## Gantries

<b>Item 5 Horizontal Member Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Steel corrosion	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Damaged steel beam	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Missing bolts	Minor	1
	Moderate	2
	Warning	3
	Severe	4

Item 5		Horizontal Member Defect Photos	
D = 1			
Left DER-U 111-1			
Right DER-U 111-2			
	Minor corrosion	Rust-repaint member	
D = 2			
Left DER-U 222-2			
Right DER-U 223-3			
	Moderate corrosion	Site weld corrosion	
D = 3			
Left DER-U 313-4			
Right DER-U 333-3			
	Site weld at midspan corrosion	Member rusting, slight damage to alignment	
D = 4			
Left DER-U			
Right DER-U			







**Gantries**

<b>Item 6 Sign Face Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Vegetation growth	Trees/bushes in front of sign face making sign difficult to read	1-2
Unclear or damaged lettering.  Lettering has been removed.	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Damaged steel sign face	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Missing bolts or nuts that link sign profile sections	Minor	1
	Moderate	2
	Warning	3
	Severe	4

Item 6		Sign Face Defect Photos	
D = 1			<p>Lettering starting to decay and peel away</p> <p>Blue background starting to deteriorate</p>
Left DER-U 121-1			
Right DER-U 121-2			
D = 2			<p>Sign face damaged - increase vert. clearance</p> <p>Sign face damaged - increase vert. clearance</p>
Left DER-U 212-3			
Right DER-U 222-3			
D = 3			
Left DER-U 333-3			
Right DER-U			
	Sign face damaged and removed		
D = 4			<p>Sign damaged from collision</p> <p>Sign damaged</p>
Left DER-U 434-4			
Right DER-U 434-4			



**Gantries**

<b>Item 7 Sign Fastener Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>
Steel corrosion	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Damaged steel fixing bracket.  Repair, strengthen or replace	Minor	1
	Moderate	2
	Warning	3
	Severe	4
Missing bolts and/or nuts	Minor	1
	Moderate	2
	Warning	3
	Severe	4

Item 7		Sign Fastener Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U 111-3			
	Fixing bracket slightly corroded	Rust-repaint	
D = 2			
Left DER-U 232-2			
Right DER-U 232-3			
	Fixing bolts moderately corroded	Fixing bolts moderately corroded	
D = 3			
Left DER-U 323-3			
Right DER-U			
	Corrosion of fixing bracket and bolts in warning state		
D = 4			
Left DER-U 434-4			
Right DER-U			
	Signboard fasteners damaged and rusting		


**2.5 Road Tunnel**

<b>Item 1 Portal Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>

Item 1		Portal Defect Photos	
D = 1			
Left DER-U 111-2			
Right DER-U			
	Clean Painted Concrete Surface		
D = 2			
Left DER-U			
Right DER-U			
D = 3			
Left DER-U 324-2			
Right DER-U			
	Seal cracks		
D = 4			
Left DER-U			
Right DER-U			


**Road Tunnel**

<b>Item 2 Slope Protection Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>

Item 2		Slope Protection Defect Photos	
D = 1			
Left DER-U			
Right DER-U			
D = 2			
Left DER-U 222-2			
Right DER-U			
	Cracks, leaching		
D = 3			
Left DER-U			
Right DER-U			
D = 4			
Left DER-U			
Right DER-U			

<b>Item 3 Rock Fall Protection Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>

**Item 3 Rock Fall Defect Photos**

D = 1		
Left DER-U		
Right DER-U		
D = 2		
Left DER-U 222-R		
Right DER-U		
	Rock fall protection	
D = 3		
Left DER-U		
Right DER-U		
D = 4		
Left DER-U		
Right DER-U		



<b>Item 4 Drainage Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>

Item 4 Drainage Defect Photos		
D = 1		
Left DER-U		
Right DER-U		
D = 2		
Left DER-U		
Right DER-U		
D = 3		
Left DER-U		
Right DER-U		
D = 4		
Left DER-U		
Right DER-U		

<b>Item 5 Road Surface Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>

Item 5 Road Surface Defect Photos		
D = 1		
Left DER-U		
Right DER-U		
D = 2		
Left DER-U		
Right DER-U		
D = 3		
Left DER-U		
Right DER-U		
D = 4		
Left DER-U		
Right DER-U		



<b>Item 6 Lining Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>

Item 6		Lining Defect Photos	
D = 1			
Left DER-U			
Right DER-U			
D = 2			
Left DER-U			
Right DER-U			
D = 3			
Left DER-U			
Right DER-U			
D = 4			
Left DER-U 421-2			
Right DER-U 422-2			
	0.8 mm crack in ceiling	2 mm longitudinal crack in ceiling	

<b>Item 7 Joints Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>

Item 7      Joints Defect Photos		
D = 1		
Left DER-U		
Right DER-U		
D = 2		
Left DER-U		
Right DER-U		
D = 3		
Left DER-U		
Right DER-U		
D = 4		
Left DER-U		
Right DER-U		

<b>Item 8 Operational Services Defects</b>		
<b>Defect</b>	<b>Observations</b>	<b>D</b>

Item 8		Operational Defect Photos	
D = 1			
Left DER-U 111-3			
Right DER-U			
		Replace traffic signs with LED signs	
D = 2			
Left DER-U 243-2			
Right DER-U			
		Replace switchgear for fans	
D = 3			
Left DER-U			
Right DER-U			
D = 4			
Left DER-U			
Right DER-U			

### 3 Make Safe Items







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#### 3.1 Defects that should be marked as “Make Safe” Items

If a defect is critical to the structural integrity such that collapse is imminent or where public safety risk is considered high, such a defect should be recorded as Make Safe (MS) and should receive immediate attention. The inspector should immediately alert the authorities to implement appropriate safety measures to ensure the safety of the user. Proof of the communication should be kept clearly indicating the authority and person(s) contacted.

The “Make Safe” box on the inspection form must be ticked.

**Examples of defects that should be marked as “Make Safe” items**

D = 4		
Left DER-U 424-4		
Right DER-U 414-4	Pavement layer undermined by stormwater	Manhole cover missing in pedestrian walkway
D = 4		
Left DER-U 434-4		
Right DER-U 424-4	Impact damage to parapet	Impact damage to parapet
D = 4		
Left DER-U 424-4		
Right DER-U 424-4	Impact damage to parapet / end block	Severe erosion at approach embankment
D = 4		
Left DER-U 444-4		
Right DER-U 414-4	Missing handrails on pedestrian bridge	Exposed live wiring on pedestrian walkway

### **3.2 Defects that do not warrant to be marked as “Make Safe” (MS) items**

These examples that were marked as “Make Safe” in previous inspections are defects that should not be regarded as “Make Safe” items. If immediate action is not required to ensure the safety of the road user then these defects should not be marked as “Make Safe” items.

**Examples of Defects that should not be marked as “Make Safe” Items**

			
<p>Left DER-U 412-4</p>			<p>Right DER-U 423-4</p>
<p>Manhole cover missing in median channel</p>		<p>Down chute partly washed away</p>	
			
<p>Left DER-U 333-4</p>			<p>Right DER-U 222-1</p>
<p>Debris blocking water way</p>		<p>Spacer blocks missing</p>	
			
<p>Left DER-U 212-1</p>			<p>Right DER-U 111-1</p>
<p>Impact damage to guard rail</p>		<p>Nut missing</p>	
			
<p>Left DER-U 313-3</p>			<p>Right DER-U 313-1</p>
<p>Guard rail not attached to end block</p>		<p>Scupper blocked and rusted</p>	