Types of Rating Systems

- Two main types of rating systems:
  - –Condition based systems
  - –Defects based systems

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Condition Based Systems

- Rate the condition of the:
  - Structure as a whole; or
  - Parts of the structure; or
  - Structural elements.
- Condition is rated on a numerical scale
  - For example 1 to 9; or 1 to 5
- Use descriptions of **condition states** to decide what the applicable rating is

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Condition States for Reinforced Concrete Elements (Pontis)

Condition State 1:

Reinforced concrete element has little or no deterioration. There may be cracking, leaching, staining, or surface scale – there is no notable delamination or spalling. The member has no impact damage or repair patches

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Condition States for Reinforced Concrete Elements (Pontis)

Condition State 4:

Reinforced concrete element has severe or critical deterioration. The load-carrying capacity of the element has been significantly reduced – structural analysis or immediate repairs may be required. Severe structural cracking (from shear or flexure) may be present. Spalling may be extensive or severe – exposed reinforcement may have significant section loss. The element may be severely damaged or significantly out of position or alignment – connections may have failed

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Defects Based Systems

- **Defects** on the structure are identified
- The worst **defects** are rated
- The **defect** ratings are used to calculate the condition of the structure

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The DER Rating System

Defects are rated using the DER rating methodology

D	• Degree of defect
E	• Extent of defect
R	• Relevancy of defect

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The DER Rating System

D = DEGREE of defect	How bad or severe is the defect
E = EXTENT of defect	How common is the defect on the inspection item being inspected
R = RELEVANCY of defect	Considers the consequences of defects with regard the **structural integrity** of the structure or the **safety of the user**

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The DER Rating System

- Defects are identified at inspection item level
- Inspection items are predefined per structure type
- The number of predefined inspection items per type of structure is as follows:

21	• Bridge (General)
14	• Major Culvert & Bridge (Cellular)
5	• Lesser Culvert

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Bridge (General): 21 Inspection Items

GENERAL ITEMS (12)	
1.	Approach embankments
2.	Guardrail
3.	Waterway
4.	Approach embankment protection works
5.	Abutment foundations
6.	Abutments
7.	Wing/retaining walls
8.	Surfacing
9.	Superstructure drainage
10.	Kerbs/sidewalks
11.	Parapets/handrails
21	Miscellaneous items

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SUPPORT ITEMS(6)

12. Pier protection work
13. Pier foundations
14. Piers & Columns
15. Bearings
16. Support drainage
17. Expansion joints

SPAN ITEMS (3)

18. Longitudinal members
19. Transverse members
20. Deck slab

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Bridge Inspection Sub-items

1. Approach Embankment
4. Approach Embankment Protection Works
5. Abutment Foundations
6. Abutments
7. Wing/Retaining Walls

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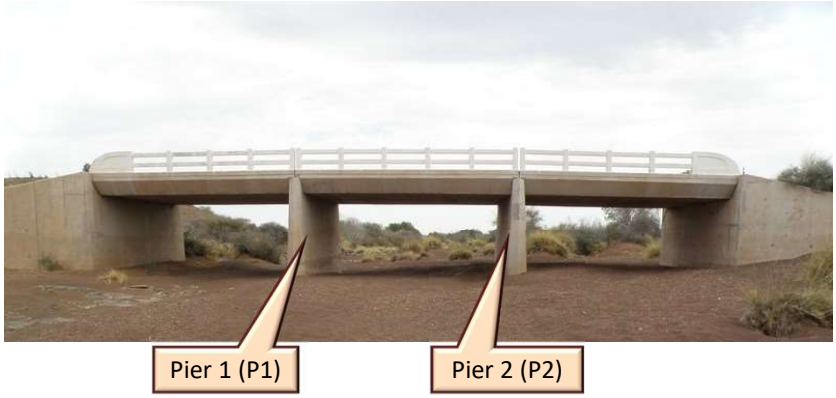
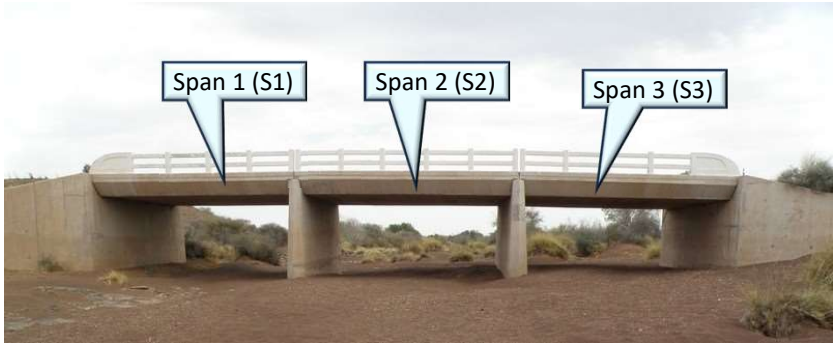
Bridge Inspection Sub-items



12. Pier Protection Works
13. Pier Foundation
14. Piers & Columns

13

Bridge Inspection Sub-items

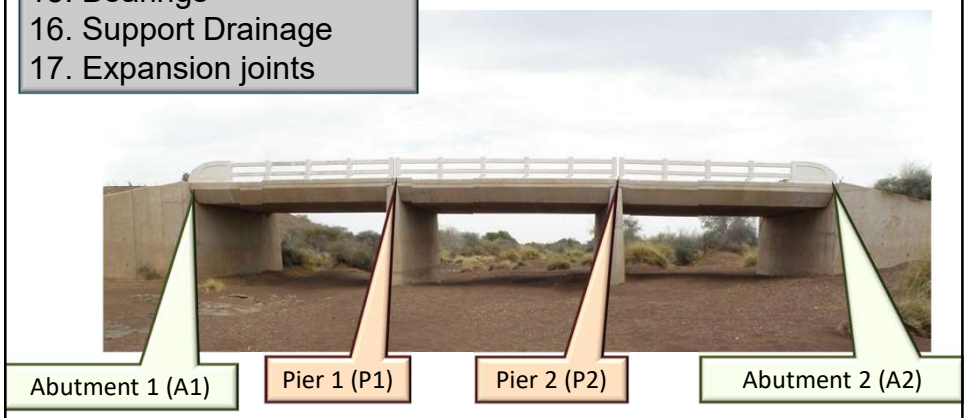


18. Longitudinal Member
19. Transverse Member
20. Deck Slab

14

Bridge Inspection Sub-items

15. Bearings
16. Support Drainage
17. Expansion joints



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Major Culvert: 14 Inspection Items (same for Bridge (Cellular))

GENERAL ITEMS (10)

1. Apron slab & cut off walls
2. Wing/return/head walls
3. Scour protection works (in river)
4. Embankments
5. Waterway
6. Road slabs
7. Roadway joints
8. Guardrails
9. Parapets/handrails
14. Miscellaneous items

CELL ITEMS (4)

10. Walls (or pipe culverts)
11. Top slab
12. Invert slab
13. Cell displacement

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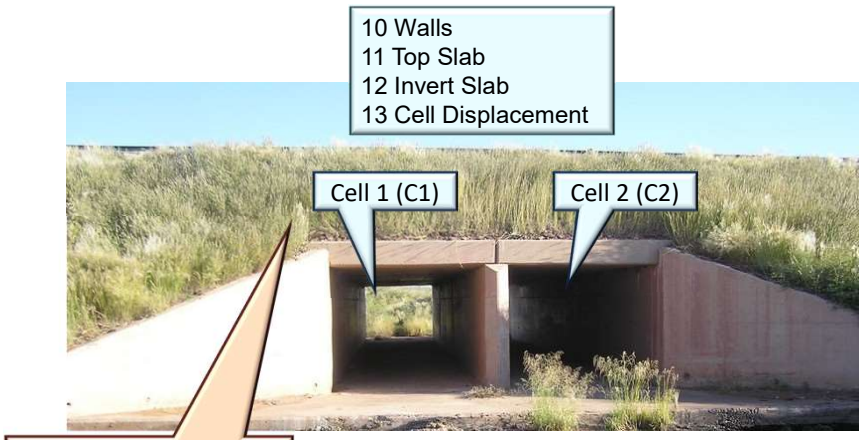
Major Culvert Inspection Sub-items



1. Apron Slabs & Cut-off Walls
2. Wing/Ret/Head Walls
3. Scour Protection Works (in river)
4. Embankments

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Lesser Culvert: 5 Inspection Items

1. Inlet works
2. Outlet works
3. Barrel(s)
4. Waterway
5. Embankments

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The Condition Assessment

- Each inspection item (and sub-item) has to be inspected
- Identify all defects on an inspection item or sub-item
- Decide on the worst defect (defect with the highest **Relevancy**)
- Rate this defect in terms of D, E and R
- This then becomes the rating for that inspection item or sub-item
- Record a remedial activity for this defect

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The Condition Assessment

- Record all other types of defects on this inspection item
- This is done by recording remedial activities for all other defects on this inspection item
- Take at least one photo per type of defect

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15 mm crack in mass concrete wing wall at Abutment 1

Need to decide:

How bad is the crack? (D = ?)

What is the extent of the defect? (E = ?)

What is the consequence of this defect in terms of structural integrity or safety of user? (R = ?)

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DER Rating System

- D; E; and R are rated on a 4-point scale
- Allowable rating values are 1, 2, 3 or 4
- A 4-point scale does not allow for an “average” rating

Degree Ratings

Rating	Description
1	Minor
2	Moderate
3	Warning
4	Severe

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Additional Degree Ratings

Rating	Description
X	Not applicable
U	Unable to inspect
0	None

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Extent Ratings

Rating	• Description
1	• Local
2	• More than local
3	• Less than general
4	• General

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Relevancy Ratings

Rating	Description	Explanation
1	Minimum	No structural integrity or safety issues
2	Moderate	Some possible structural integrity or safety issues
3	Major	Structural integrity or safety compromised
4	Critical	Potentially a serious impact on structural integrity and/or user safety

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Summary of DER Ratings

Rating	Degree	Extent	Relevancy
X	Not applicable		
U	Unable to inspect		
0	None		
1	Minor	Local	Minimum
2	Moderate	More than local	Moderate
3	Warning	Less than general	Major
4	Severe	General	Critical

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Cases when E and R Ratings are not applicable

If D = X or U or 0 → Leave E and R blank

If D = 1, 2, 3 or 4 → E and R ratings have to be entered

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Relationship between D and R

R rating cannot be more than
1 point higher than D rating

Valid DR combinations		R			
		1	2	3	4
D	1	11	12	13	14
	2	21	22	23	24
	3	31	32	33	34
	4	41	42	43	44

15 mm crack in mass concrete wing wall

D = 4
E = 1
R = 2

Now need to decide:

What remedial activity is required?

What is the quantity of the remedial activity?

How **Urgent** is it to repair the defect?

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Remedial Activities

- Each type of defect that is identified must be recorded
- At least one remedial activity must be associated with the defect
- Remedial activities are selected from a remedial activity list
- The following information regarding the defect must be recorded:
  - Position (item and sub-item)
  - Remedial activity (from list)
  - Estimated quantity of remedial activity
  - **Urgency of the remedial activity**

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Urgency Rating of Remedial Activity

R = Record only	• No remedial work on the defect is envisaged • D will be 1 or 2 and R will be 1
0 = Monitor only	• Remedial work on the identified defect is not envisaged for the foreseeable future • Monitoring frequency must be indicated (e.g. 12, 24, 36 months) • Should not be used frequently
1 = Routine	• Use for remedial activities identified as routine activities in the remedial activity list • Do not use for routine defects with a high Relevancy (3 or 4)
2 = Within 10 years	• After the next round of principle inspections
3 = Within 5 years	• Before the next round of principle inspections
4 = As soon as possible	• Would usually be within 2 years

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Urgency Rating of Remedial Activity

- Urgency rating is an indication of how soon a defect should be repaired
- The urgency rating is used in the budget module to allocate budgets to a specific budget period
- **U**rgency rating must relate to the **R**elevancy rating
  - (e.g. if R = 4, U cannot be 1)

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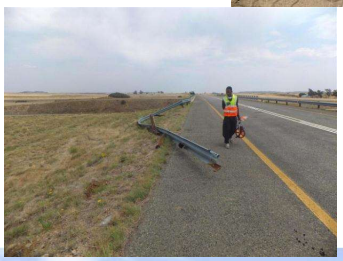
Make Safe Items

- A remedial activity is marked "**Make Safe (MS)**" where the risk to public safety is considered high
- This is a defect that must receive **immediate attention**
- Make Safe activities will always be allocated an **urgency rating of 4**

Examples of Make Safe Items



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15 mm crack in mass concrete wing wall

D = 4
E = 1
R = 2

Position of wing wall:
on eastern side at abutment 1

Remedial Activity									
Item	Pos	Activity	Qty	Unit	U	MS	Remarks	Mon Freq	Photos
07	A1	07.120. Seal cracks	2	m	2		15 mm crack in north-east wing wall	-	S08

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Advantages of the DER system

- The bridge inspector is not required to condition rate each and every element
- Only elements with defects are rated for DER and then only the most significant defect with highest relevancy
- Time on site is reduced as the inspector is only looking for defects and not trying to estimate a condition rating for the structure

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