

SUPERSTRUCTURE INSPECTION AND RATING

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Introduction

- Superstructure is the portion of the bridge above the caps
- Purpose
 - Carry traffic
 - Transfer loads to substructure
- Component materials
 - Timber
 - Concrete
 - Steel
 - Combination

Superstructure Components:

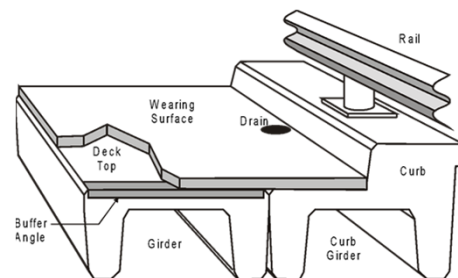
- Bearings
- Stringers or girders
- Deck or subdeck
- Deck joints
- Deck wearing surface
- Drains
- Curbs or Wheel Guards
- Bridgerail
- Sidewalks (if present)

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Standard Girder Bridge

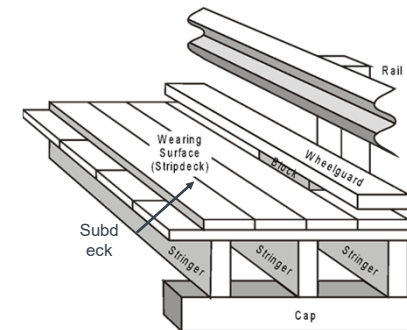


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Timber Bridge



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Introduction

- Two form types;
 - TT – treated timber bridges
 - PCS - Standard precast bridges (either plain reinforced or pre-stressed)
- Both are tailored for components in each type of bridge



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Material Defects

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Material Defects - Timber

Structural Failure/Degradation

- due to loads placed on structural members
- overloads, collisions, poor grain pattern
- look for cracks, splits, breaks in structural members
 - stringers, timber posts, rails, etc.

Decay

- caused by fungi
- needs moisture, oxygen and conducive temperature
- pressure treatment delays growth
- look for discoloration (white stains coming from cracks, dampness of wood, ring shrinkage at end grain, hollow sounds, change in geometry)
- look in areas likely to retain moisture
 - bearing or contact areas, buried timber
- look in areas where treatment is broken/cut
 - bolts, drifts, dowels, cuts, cap ends

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Material Defects - Timber

- Volume Change
 - caused by cycles of wetting and drying creating stress in wood
 - look for checks, cracks, warps, twists, etc.
- Mechanical Wear
 - caused by abrasion from traffic, snowplows, ice flow, debris
 - look in area subject to wear/abrasion - deck surface, wheelguard
- Fire
 - easily recognized
 - reduces the load capacity by reducing the effective section of the member
 - removes pressure treated zone on the exterior exposing timber to fungal attack

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Material Defects - Concrete

- Structural Cracks
 - caused by stresses higher than design
 - Flexural – generally not serious unless wide or growing in width
 - Shear - most serious - can lead to failure
 - Anchorage can be serious depending on cause
- Shrinkage Cracks
 - caused by rapid drying during hydration
 - usually not serious by themselves but let moisture and salt into the concrete (e.g., new conc. deck)
- Settlement Cracks
 - caused by settlement of the falsework
- Map Cracks
 - chemical reaction of the aggregate and paste
 - usually shallow, from over-finishing
 - can cause scaling

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Material Defects - Concrete

Corrosion Cracks

- caused by corrosion of steel in the concrete creating delamination's or spalls.
- varying widths, locations and orientations
- Maintenance or rehab problem

Chipping

- caused by external mechanical (grader blade, backhoe arm)

Scaling

- caused by freeze/thaw action
- related to poor concrete or workmanship

Spalling

- caused by corrosion of rebar

Popouts

- caused by expansive aggregates

Punchouts

- External mechanical that causes tension failure on opposing side

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Material Defects - Concrete

- Efflorescence
 - white salt stains
 - may be associated with cracks which allow water to get into concrete
- Exudation
 - gel-like substance deposited on surface
 - may be associated with cracks which allow water to get into concrete
- Chemical Attack
 - caused by sulfates in the soil reacting with the concrete
 - increases the volume of the concrete causing cracks

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Shear Cracks



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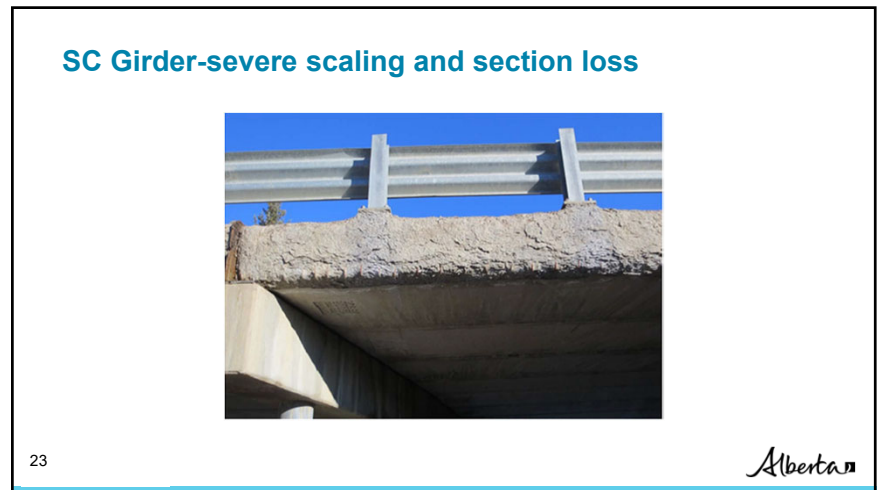
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Girder Punchouts



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Material Defects - Steel

- Corrosion
 - caused by the presence of oxygen and moisture
 - reduces section of steel member
 - can significantly reduce the load-carrying capacity
 - Increases the risk of fatigue failure
 - Look in areas prone to the retention of moisture or exposure to salt
 - Splash areas, under leaky joints or drains, dirt, and debris accumulation
- Cracks
 - Caused by fatigue, overload, or collision
 - Initially may be too small to be seen by the eye
 - can progress rapidly
 - look in high-stress or fatigue-susceptible areas
 - welds, holes, notches, collision locations, connections, bearing locations

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Material Defects - Steel

- Deformation
 - caused by fire, collision, overload or thermal stresses
 - May be local buckling of part of member i.e., web or flange
 - entire member may be bent, twisted or buckled
 - look in high stress areas
 - collision locations, bearing locations

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TT Form

PCS form

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Special Features

- Bridge elements unique to a particular bridge
- Which cannot be rated under another element or area of the form
- May be permanent or temporary
- Lights & WSC station are utilities
- Examples include:
 - strengthening systems, girder clips
 - temporary bents

Bridge Component	Superstructure		Explanation of Condition
	Last	Now	
Primary Span - PCS			
Special Feature			
Special Feature			
Special Feature			
Special Feature			

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Special Features

- Record Type(s) – up to 2
- Use Explanation of Condition for additional information
 - description
 - location
 - dimensions
- Check damage or defects common to the materials and type of component
- Provide suitable rating
- Make a comment if bird nests are present under the bridge in "Explanation of Condition Field" (e.g., "bird nests at deck underside")
- Refer to Section 7.3 in BIM Manual

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Special Features

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Special Features



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Wearing Surface

TT forms


Wearing Surface/Deck Top Detail Ratings				
	1 (N)	2 (N)	3 (N)	
Least				
Most				
Wearing Surface/Deck Top				
(Material Type :)				
(Plank Thickness(es) :)				
(Plank Width(s) :)				

PCS forms

Wearing Surface/Deck Top Detail Ratings				
	1 (N)	2 (N)	3 (N)	
Least				
Most				
Wearing Surface				
(Material Type :)				
(Lateral Connection Problem (Y/N))				

PCS (precast or pre-stressed standard)

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Wearing Surface

- Bonded or fastened to the bridge deck
- In direct contact with the wheels of the vehicles
- List of types in Section 7.4.2 of the BIM manual
- Loose or frozen gravel is not a wearing surface
- Purpose
 - Protect the deck
 - Provide a smooth riding surface
 - Provide skid resistance

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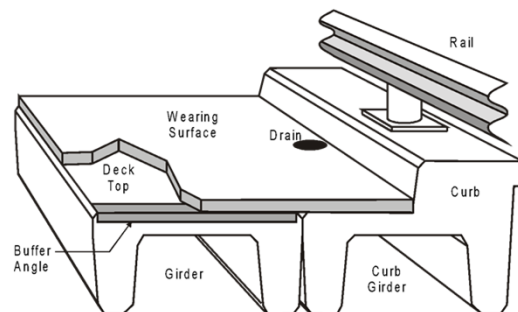
Wearing Surface

- TT form combines wearing surface and deck top
- If no wearing surface rating is for deck top only
- Verify the wearing surface material type on the report
- Record or verify the average thickness in mm
- Record the width and thickness of timber planks for TT form
- Y/N - is there a lateral connection problem between girders? If Y comment
- HC - bolted connectors; PA - bolted legs; PE - grout keys; PG, HH – none

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Standard Girders with Wear Surface

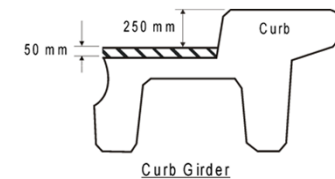


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Wearing Surface - Thickness

- Measure at curb
 - Most standards curbs 300mm high
 - Refer to plans if in doubt
- Take readings at ends and midspan, and average
- Wearing surface may be thicker at centerline than at curb



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Wearing Surface

- Drive over the deck at fastest safe speed
- Observe traffic to assist in rating
- Look for material defects
- For asphalt pavement wearing surfaces look for:
 - cracks (alligator, lane joint, shrinkage and slippage)
 - distortion (ruts, depressions and corrugations)
 - disintegration (potholes and raveling)
 - segregation
- Check for delaminations in concrete and asphalt wearing surfaces and record amount in percentage of deck area

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Wearing Surface

- If surface is without defects and provides a smooth riding surface with proper skid resistance - rate 9
- Asphalt longitudinal cracks rate 7 or less,
- If speed must be reduced due to cracks, potholes, etc, - rate 4 or less
- If wearing surface does not extend to the curbs and creates a wheel trap - rate 4 or less
- Asphalt raveling rate 4 or less
- Rutting, potholes or debonding rate 4 or less
- Hazardous rate 2
- Do not rate down due to excessive thickness (100 mm or more)
 - Lower curb rating if height insufficient
 - Request load rating evaluation
 - Recommend reducing thickness

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Wearing Surface

- Record % of surface area with defects and rated 1, 2 or 3 in Detail Rating boxes
- Record % of surface area rated N
- Wearing surface rated 4 or above, Detail Ratings are "0"

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Wearing Surface

Bridge Component		Superstructure		Last	Now	Explanation of Condition
(Primary Span: CH , 3 Spans, Lengths(m): 8.5-8.5-8.5, A-Ident Number:)						
Special Features						
Special Feature (Type -)						X
Special Feature (Type -)						X
Wearing Surface/Deck Top Detail Rating						
	N (%)	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
Last	0	0	0	0	0	5
Now	0.0	0.0	0.0	0.0	25.0	0
Wearing Surface (Material Type: ACP - CHIP SEAL COAT)				3	2	ACP Cracking between all girders up to 230mm ACP missing on S span along PG girders. Worst on NBL.
(Thickness(mm) 50)						
Vertical Connection Problem (Y/N)	No					Not connected
Deck Top				N	N	Paved over
Deck Rideability				4	3	Due to wide gaps up to 230mm wide along girders and missing sections of ACP.
Deck Joints				N	N	Paved over.
Bump (Y/N)	No					

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Deck Top

- Deck Top is the “structural” part of the deck
- The surface on which the wearing surface is bonded
- If no wearing surface, the deck top is in direct contact with traffic
- Types:
 - Cast-in-place concrete
 - Precast concrete girders

Superstructure			
Bridge Component	Last	Now	Explanation of Condition
Deck Top			

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Deck Top

- Purpose:
- Carry traffic
- Transfer traffic loads to main structural members
- Provide smooth riding surface
- Provide skid resistance
- Rated with wearing surface on TT forms

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Deck Top

- Listen for unusual noises and look for deflections under traffic
- Look for material defects
 - Concrete - cracks, scaling, spalling, popouts, abrasion from traffic
 - Timber - missing and loose planks, cracks, splits, rot, wear from traffic
- Look for unfilled lift and connector pockets on precast girders
- Rating of wearing surface does not affect the deck top rating

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Deck Top

- Deck smooth, no defects, rate 9
- Good condition with hairline cracks, rate 7
- If speed reduced due to potholes, etc., rate 4 or less
- Record % area rated 3, 2, 1 and N in Detail Rating boxes
- Deck top rating 4 or more record 0 in Detailed Rating boxes
- Rate 3 or less for severe scaling/spalling/debonding
- Hazardous conditions rate 2
- If defect on precast or pre-stressed girder deck top is severe enough to affect load carrying capacity then girder rating should also be consistent

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Deck Top

Superstructure				
Bridge Component	Last / Now / Explanation of Condition			
(Primary Span PG, 1 Spans Lengths(m): 6.1, A-Ident Number:)				
Special Features				
Special Feature (Type :)				X
Special Feature (Type :)				X
Wearing Surface/Deck Top Detail Ratings				
	N (%)	1 (%)	2 (%)	3 (%)
Last	0	0	0	0
Now	20.0	0.0	0.0	0.0
Wearing Surface (Material Type :)	None			
(Thickness(mm) :)	No connection.			
Lateral Connection Problem (Y/N)	No			
Deck Top			5	5

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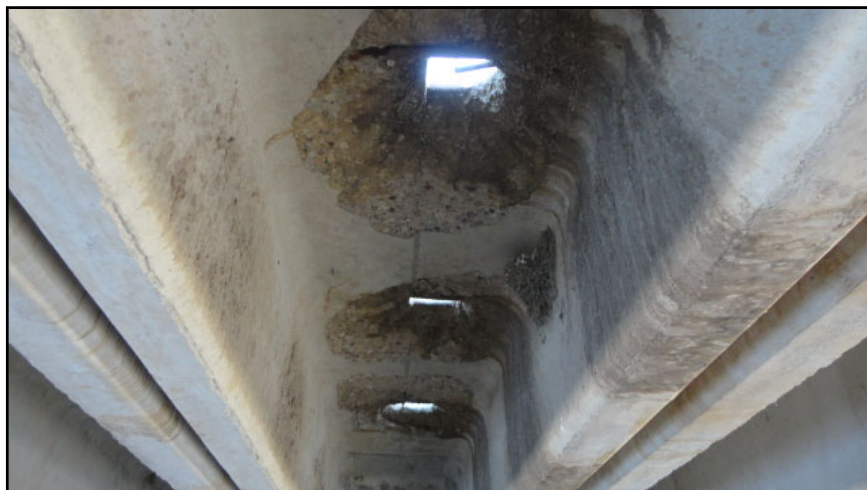
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Lateral Connection Problem Y/N

Wearing Surface/Deck Top Detail Ratings				
N (%)	1 (%)	2 (%)	3 (%)	
Last				
Now				
Wearing Surface				
(Material Type :)				
(Thickness(mm) :)				
Lateral Connection Problem (Y/N)				

PCS (precast or pre-stressed standard)

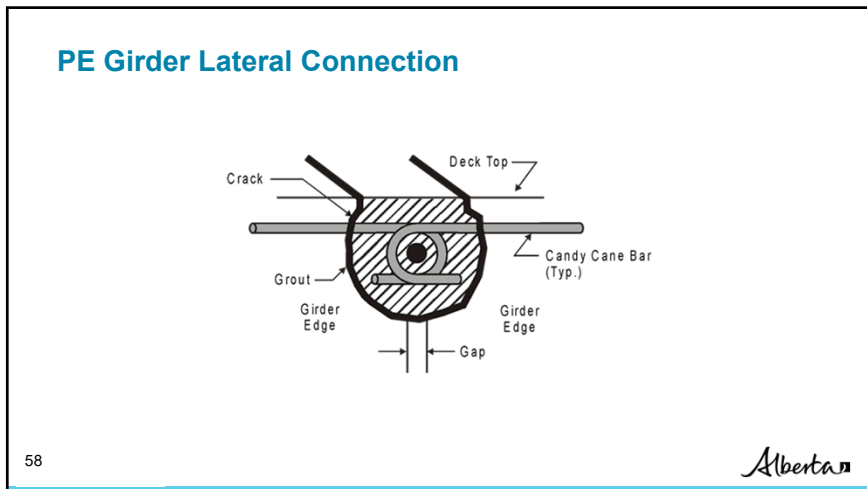
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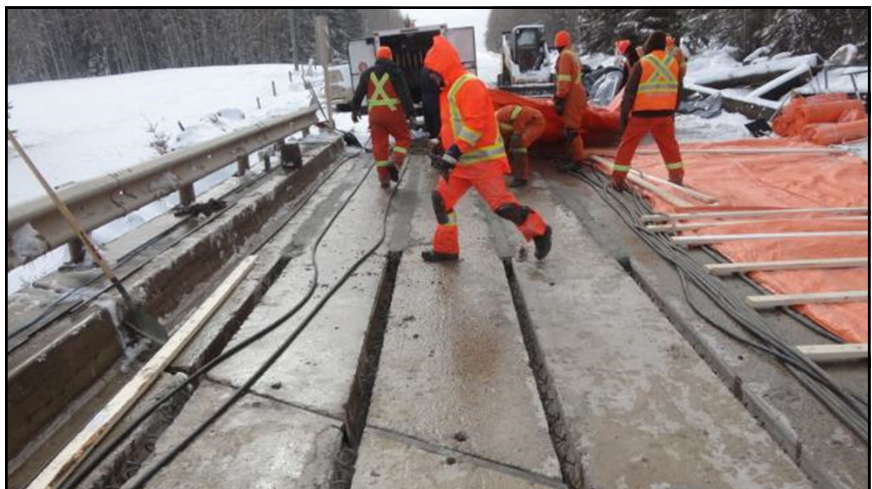


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Deck Rideability

- A measure of the riding comfort at the legal speed
- Influenced by the condition of the wearing surface or deck top and joints (rated separately)
- Drive over at legal speeds and assess ride quality
- Listen for unusual noise from traffic
- Observe traffic for signs of poor rideability such as slowing down or bouncing
- Smooth, no speed reduction rate 7 or more
- If speed has to be reduced due to potholes, etc. - rate 4 or less
- Slipperiness reduces rating

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Hazardous Wear Surface due to failing ACP



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Deck Joints

- Purpose
 - Provide a structural termination of individual spans
 - Can be designed to prevent water and salt from leaking down onto substructure
 - Protects ends of precast girders (buffer angles)
 - Can be designed to span gap between spans
 - Provide a smooth transition (reduces bumps)
- On standard bridges all joints are considered fixed.
- Not applicable to standard TT bridges

Bridge Component	Superstructure		
	Last	Now	Explanation of Condition
Deck Joints			
Bump (Y/N)			

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Deck Joints

- Standard Bridge Types
- Buffer angles - steel angles cast into top edge at ends of girder
- Compression seal - a compressible seal held in place by steel angles
- Strip seal installed at piers of overlays
- Others - caulked saw cuts, asphaltic plug joint (Koch or Thorma-joint)
- Asphalt fiber board alone is not a joint – rate X
- Unprotected girder ends is not a joint – rate X

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Deck Joints

- Observe traffic crossing over joints
- Listen for unusual noises
- Watch for movement
- Look for:
 - Vertical alignment
 - Corrosion
 - Deteriorating concrete around anchorages
 - Damage from snowplow
- Indicate whether or not a significant bump by Yes or No
- If "Yes", explain location and cause

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Deck Joints

- Buffer angles should not be rated down because they leak
- Damage from leakage rated in substructure
- Slightly less than adequate but no maintenance required – rate 4 (missing section of buffer angle)
- Joints requiring repair – rate 3
- Joints which are a hazard to traffic - rate 2 or less
- If joint is not visible:
 - Rate "X" if it is known that no joint exists
 - Rate "N" otherwise
 - Provide explanation

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Missing Buffer Angles – Rated 5



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Void under Buffer Angle – Rated 3



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Deck Drainage

- Ability of the deck to drain and properly dispose of water from its surface
- Not applicable to bridges with timber decks
- Drainage system includes gutters, inlet boxes, pipes and catch basins

Superstructure			
Bridge Component	Last	Now	Explanation of Condition
Deck Drainage			
Drains Clogged (Y/N)			

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Deck Drainage

- Poor drainage
- Common cause of deck deterioration
- May be hazardous due to hydroplaning or icing
- Caused by inadequate design, construction or maintenance practices (grade, crown, debris, etc)
- May affect other superstructure components, substructure, headslopes and sideslopes

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Deck Drainage

- Indicate whether or not the drains are plugged by Yes or No
 - If no drains, note in Explanation of Condition
- Check drainage system - determine if water is properly directed off deck
- If there are any deficiencies in the drainage system or significant deterioration of any components - rate 4 or less
- If erosion is being caused on the headslopes or sideslopes by deck drainage - rate 4 or less
- If water is ponding on deck and creates a hazard for traffic - rate 2 or less
- Not a factor on timber decks therefore rate X

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Curbs/ Medians

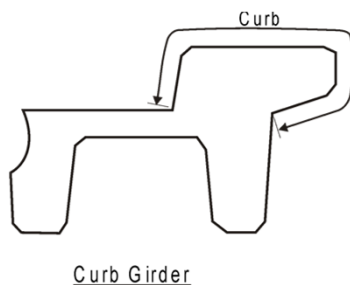
- Raised surface at the edge of the roadway
- Purpose
 - Guide or redirect traffic
 - Divide the bridge according to travel direction
 - Anchor railing posts
- Applies to concrete only - timber or steel called wheel guards

Superstructure			
Bridge Component	Last	Now	Explanation of Condition
Curb/Median			
Scaling (Percent Area)			

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Curbs/ Medians



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- Curb consists of:
 - the vertical or sloped face along the edge of the roadway
 - the raised horizontal surface
 - the fascia or outside surface down to the deck or girder level

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Curbs / Medians

- Look for:
 - Scaling
 - Other material defects - cracks, delaminations, spalls
 - Snowplow damage along inside faces
 - Accident damage
 - Holes exposing the voids
 - Water in voids and associated freezing damage
 - Whether curb lift hook pockets are filled
- Estimate the amount of scaling as a percentage of the total area
 - Record the percentage in the appropriate field
 - Describe the extent and location in the *Explanation of Condition*
 - Scaling is not normally a problem on gravel roads unless using calcium chloride for dust control

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Curbs / Medians

- Note any loss of height due to excessive roadway paving or accumulation of dirt or gravel
- Rate according to condition and ability to perform as designed
- Condition of concrete
- Ability to withstand and redirect traffic
- Ability to contain railing anchors in the event of a collision
- Curbs with holes or exposed voids allowing water - rate 4 or less
- Severe scaling (>25 mm deep) - rate 4 or less
- Reduced height (>25%) due to excess gravel or overlay – rate 4 or less
- Spalling or broken concrete affecting post anchorage - rate 3 or less

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Curb and Post rated 3



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Curb and Post Rated 3

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Curb holes – Rated 3

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SC Girder Deterioration at Plinth

- Curb is rated "X" in the example
- Plinth deterioration is rated under bridgerail post section on form.



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Wheel Guard

- Curbs made out of timber or steel
- Found on timber decks
- Verify type, height and width
- Record in nominal dimensions (typ. size is 100 x 300 or 150 x 300 but some variations)
- Revise as req' in inventory area on form
- Add this information if missing
- Record wheel guard block dimensions in comments area if needed

Wheel Guards	
(Curb Type :)	
(Type :)	
(Curb Height(mm) :)	
(Width(mm) :)	

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Wheel Guard

- Look for:
 - Poor anchorage
 - Material defects
 - Missing or loose bolts
 - Poor connections
 - Mis-alignment
 - Collision damage
 - Snowplow damage
 - Missing sections
- Note any loss of height due to roadway paving or accumulation of dirt or gravel
- Rate according to condition and ability to perform as designed
- Minor splits/cracks rate 5
- Missing/broken sections, blocks, anchors rate 4 or less

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Grader damage to TT Wheelguard – Rated 4 or less



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Bridge Rail & Posts

- Considered to be safety features
- Do not contribute to the strength or load carrying capacity of the bridge
- Refer to Section 7.11.2 in the manual for a list of railing and post types
- Verify railing and post types – correct/add in inventory area
- Record coating type on rails and posts
- Record number of layers of flexbeam in comments

Superstructure			
Bridge Component	Last	New	Explanation of Condition
Bridge Rail			
(Type:)			
Bridge Rail Posts			
(Type:)			
Bridge Rail/Posts Coating			
(Type:)			

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Bridge Rail & Posts

- Look for:
- Material defects (corrosion, cracks)
- Collision damage
- Horizontal and vertical misalignment
- Loose connections
- Missing nuts or bolts
- Inadequate thread engaged on post anchor nuts (< 2 threads projecting)
- Broken or spalled post anchors
- Correct lap direction of flexbeam
- lapped in direction of traffic
- Includes pedestrian rails found on sidewalks

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Bridge Rail & Posts

- Rate according to condition and not the standard of the rail, posts or coating
- Timber rail is substandard but can be rated 9 if in new condition
- Timber posts with wrong orientation
- Rating for rail and posts does not include the condition of the coating – rated separately unless severe corrosion affecting rail/post
- If coating on rail and posts is different, record and rate rail coating. Note post coating type and condition in Comment area
- Railing with minor collision damage but still functional and has good connections rate 5
- Timber with signs of rot rate 4 or less
- Rail connections with missing/loose bolts, improper laps, rate 4 or less
- Railing with missing sections - rate 2 or less

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Bridge Rail & Posts

- Post anchor bolts with at least two threads above the nut rate 8 or more
- Post anchor bolts that are engaged with full/flush nut (no thread projection above the nut) or <2 threads projecting above nut rate 7
- Post anchor bolts with insufficient thread (negative thread projection) rate 4 or less
- Post anchors that are broken or missing anchor nuts and bolts rate 3 or less

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Bridge Rail & Posts

For Bridgerail posts on SC Girders:

- Concrete section loss that does not extend to edge of post base plate – Rate 3.
- Concrete section loss extending up to or below edge of post base plate – Rate 2.
- Exposed exterior stirrups within 500 mm longitudinally of bridgerail post – Rate 2.

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Rotted Timber rail – Rated 3

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Rot in top of timber rail post – Rated 4

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Missing bridgerail section – Rated 2

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Missing Rail and Posts – Rated 2

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New W-beam Rail – Rated 9

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Anchor bolts - insufficient thread projection above nut – Rated 4



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Loose anchor bolt nuts – Rated 4



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Missing anchor bolt nut – Rated 3



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SC Girder Deterioration Affecting Post Anchorage – Post Rated 2.



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SC Girder Deterioration Affecting Post Anchorage – Post Rated 2



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Typ. TT wheelguard, TT posts, galv. rail



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Sidewalk

- Applicable to PCS bridges
- Designed to accommodate pedestrian traffic
- Not normally part of the load carrying system of the bridge
- If part of the load carrying system, rating & inspection procedures are similar to “Deck Top” and/or Girder”

Superstructure			
Bridge Component	Last	Now	Explanation of Condition
Sidewalk			

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Sidewalk

Look for:

- Smoothness, adequate traction and debris
- Accessibility for pedestrians to the sidewalk at both ends of the bridge
- Material defects
- Condition of structural members and connections
- Condition of railings (rate under bridge rail)
- Hazards to pedestrian traffic (tripping, slipping, holes, loose boards, etc.) rate 2 or less
- Rate according to condition and ability to perform as designed
- Rail systems rated with Bridgerail
- Some defects may be less serious on a sidewalk than on the bridge

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Subdeck

- Applies only to Standard TT bridges
- The "structural" part of the deck
- Strip deck usually installed on top to protect
- If no wearing surface, subdeck is in contact with traffic
- Consists of timber planks fastened to stringers
- Often only visible to inspect at underside and ends
- Verify type and revise or add as needed
 - Record in Inventory area of form.
- Record nominal width and thickness – normally 100 x 300mm

Bridge Component	Superstructure		
	Last	Now	Explanation of Condition
Sub Deck/Deck Underside			
(Material Type)			
(Plank Thickness (mm))			
(Plank Width (mm))			
Defects (Percent Area)			

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Subdeck/Underside

- Look for:
 - Material defects
 - Loose or broken planks
 - Deflection under traffic
- Estimate the percentage of the area which has defects and record value
 - Decay, staining, split or broken planks
- Minor stains/cracks (concrete) rate 5
- Spalls or severe scaling rate 4
- Rot/Decay in timber rate 4 or less
- Note location in Manual – Section 7.21

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Rot/bulging in Subdeck – Rate 3 or less

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Stringers

- Applies only to standard TT bridges
- Longitudinal beams resting on the caps and supporting the deck
- The main load carrying members of the superstructure
- Verify number per span or add if missing
- Verify type, size (width and depth), and spacing in nominal dimensions and record in Inventory area of form

Bridge Component	Superstructure		
	Leak	Now	Explanation of Condition
(No. of Stringers -)			
Stringer Detail Ratings			
	N (count)	1 (count)	2 (count) 3 (count)
Leak			
Now			
Stringers			
(Type -)			
(Width (mm) -)			
(Depth (mm) -)			
(Spacing (mm) -)			

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Stringers

- Purpose:
 - Support the deck
 - Transfer loads to substructure
 - Critical load carrying members
- Repaired or “sistered” stringers count as one stringer (repair must be with equivalent size stringer)
- Record if stringers are notched including location

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Stringer and Girder Numbering

7.13.2. Stringer/Girder Numbering

Girders or stringers are numbered west to east or south to north (see Figure 7.10).

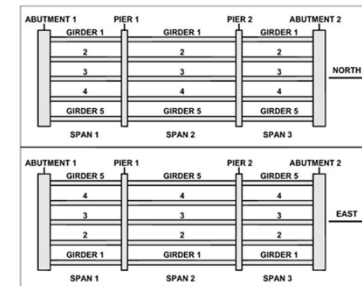


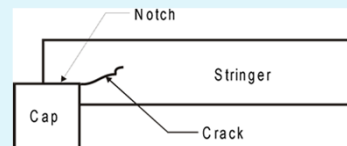
Figure 7.10 - Stringer/Girder Numbering

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Stringers

- Look for:
 - Material defects
 - decay, cracks, checks, fire damage, sags, twists
 - Broken or missing stringers
 - Adequate bearing, proper connections and any splitting, crushing or decay in bearing area
 - Collision damage or abrasion from ice or drift
 - Notches at ends in bearing zone



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Stringers

- Cracked stringers rate 3 or less
- Stringers with less than 75 mm bearing on the cap rate 3 or less
- Stringers with 75 -100 mm bearing on the cap rate 4
- Stringers that are bowed or twisted significantly - rate 4 or less
- Cracked or broken stringers which have been repaired with additional stringer(s) of equal size may be rated 5 or more
- Stringers with notches at ends - rate 7 or less and note in comments area
- Record number of stringers rated N, 1, 2 & 3 in Detailed Rating boxes. If number cannot be determined, record as 99
- If all stringers are rated 4 or more, Detail Ratings are recorded as "0"

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Rotted subdeck & rotted/cracked timber stringer. Both rated 3 or less.



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Cracked Timber Stringer –Rated 3



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Cracked Timber Stringer – Rated 3



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Cracked Timber Stringer – Rated 3



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Girders

- Applies only to concrete girder bridges
- Longitudinal beams resting on caps
- The main load carrying members of the superstructure
- The deck is integral with the girder
- Detail ratings only on PCS
- Last Complete Inspection Date

Bridge Component		Superstructure			Last	How	Explanation of Condition
		N (count)	1 (count)	2 (count)			
Girder Detail Ratings							
		N (count)	1 (count)	2 (count)	3 (count)		
Last							
How							
Girders							
Last Complete Inspection Date							
Cracking (Y/N)							
Spalling (Percent Area)							
Lift or Connector Pocket Cracked (Y/N)							
(Number Of Girders -)							

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Girders

- Purpose:
 - Support the deck
 - Transfer loads to substructure
- Two types in Standard bridges – PCS form used for both
- Channel Girders - conventionally reinforced channel girders
- Standard Prestressed – short box girders with pre-tensioned reinforcement
- Refer to BIM Reference Manual for types of girders

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Girders

FORM TYPE	DESCRIPTION	SPAN TYPE
TH	Through Trusses	TH
PT	Pony Truss	PT
SG	Rolled Beams	RB RC
	Riveted Plate Girders	RG
	Welded Girders	WG
	Steel Rigid Frames	FR
SS	Other Trusses & Arches	SSB SSA SSS SSP SSC
DT	Deck Trusses	DT
TF	All Timber Bridges	TF
PCS	Standard Prestressed Bridges	PH HC VH PG GR PE PA PS MM HGD PGD HHD PAX PFS PEF VSM VM AM SC SSM SMD VSD SCM SL SLW Web
PSR	Regular Prestressed Bridge	RD TC VF VM VM PE DDT PG PD PMO OM LF FM EM PJ HU CRT DBC CBC FCO FUD TSS
CON	All Cast in Place Concrete Bridge	CA CB CF CV CX CC CXP
	Concrete Tee Girder Bridges	CT
	Concrete Flat Slab Bridges	CS
CUL1	Single Culverts	RP SP FP WP CP BP AP BPR
CULM	Multiple Culverts	RPS CPA CPE SPE
CULE	Culverts extended with different material and/or size	PCB PPA BRE RPP MPB SCA SCR SSP CPP SPP SRM MPE
SGN	Sign Structures	S
YHT	Through Trusses with Timber Approaches	
THPS	Through Trusses with Standard Precast Approaches	
THPSR	Through Trusses with Regular Precast Approaches	
THSG	Through Trusses with Steel Girder Approaches	
THPT	Through Trusses with Pony Truss Approaches	
PTTT	Pony Trusses with Timber Approaches	
PTPCS	Pony Trusses with Standard Precast Approaches	
SGTT	Steel Beams with Timber Approaches	
SGPCS	Steel Beams with Standard Precast Approaches	
PSRPCS	Regular Prestressed with Standard Precast Approaches	
SSSG	Special Steel with Steel Girder Approaches	
DTSG	Deck Truss with Steel Girder Approaches	

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Girders

- Cracks are often the first visible sign of distress or failure
- Types of cracks:
 - Vertical hairline cracks on precast channel girders - common not serious
 - Vertical cracks in the tension zone – flexure – usually not serious unless wide
 - Diagonal cracks near supports - shear or combination of shear and flexure, can be serious
 - Longitudinal cracks in bottom of legs in precast girders – common, corrosion of rebar
 - Wide longitudinal cracks in bottom of legs with corrosion may lead to spalling
 - Longitudinal cracks in ends of prestressed girders - stresses from pre-tensioned reinforcement
 - Wide longitudinal cracks with corrosion in girder undersides of prestressed girders may be from strands and is usually serious.

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Girders

Look for:

- Cracks
- Spalling on bottom of legs
- Other defects - scaling, staining, etc.
- Damaged connectors - deteriorating grout, loose or broken bolts, corrosion on bolts or connector channels
- Spalls at dowel locations
- Collision damage or abrasion from ice or drift
- Punchouts in deck
- Look for excessive vibrations or deflections under traffic
- Observe whether girders with lateral connections deflect independently

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Girders

- Indicate cracking by Yes or No
 - Applies to all types except shrinkage and hairline or narrow flexural cracks
 - If Yes explain - location, type, size
 - Mark and date cracks
- Record the percentage of spalling on the bottom of the legs
 - Record 0% if none
 - Explain if any
- Indicate Lift or Connector Pockets Grouted
Yes or No
 - If Yes provide comment to explain
- Verify total number of girders or record number per span if blank

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Girders - Rating Guide

- Standard reinforced channel girder rating guidelines in Section 7.15.3 – Section 7.15.3.5 and are summarized Table 7.4
- Standard prestressed girder ratings in Section 7.15.4 – 7.15.4.4 and summarized in Tables 7.5, 7.6 and 7.9
- Rating guidelines for BOTH types 7.14.1 – 7.15.2.7
- Ratings given are maximums - decrease as required depending on defect
- Reflect condition and functionality
- Defect on curb girder only, can increase rating by one if traffic not on girder
- Provide girder count for N, 1, 2 & 3 ratings
- If girder ratings are 4 or above detail ratings are “0”

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Rating Guide – Table 7.4 Standard Reinforced Girders

Rating	Spalling or Longitudinal Cracks on Legs	Shear cracks (not greater than 60° from horizontal)	Other Defects
No effect			• Narrow flexural cracks.
6			• Isolated end diaphragm spall. • Narrow map cracks.
5	• Medium crack within AZ with sound concrete (must be accessible and confirmed by inspector) • Wide crack outside AZ with sound concrete	• Narrow (reduce by one if wide longitudinal crack or spall within AZ)	• Top slab transverse crack.
4	• Medium crack within AZ with unsound concrete or concrete soundness not confirmed by inspector • Wide crack within AZ with sound concrete (must be accessible and confirmed by inspector) • Wide crack outside AZ with unsound concrete or concrete soundness not confirmed by inspector • Moderate loss of section on main bars or stamp bends (up to 15%)		• Medium or wide map cracking or any map cracking with corrosion staining. • Medium flexural cracks. • Small punchouts, 150 mm or less in diameter • Narrow concrete grout key cracks. • Bearing length less than 100 mm (rate 4 or less).
3	• Wide crack within AZ with unsound concrete or concrete soundness not confirmed by inspector • Spall within AZ with a minimum of 50% of main longitudinal reinforcing steel embedded in sound concrete	• Medium (reduce by one if wide longitudinal crack or spall within AZ)	• Other punchouts. • Medium or wide concrete grout key cracks. • Failed girder connectors. • Bearing length less than 75 mm (rate 3 or less).
2	• Spall within AZ with less than 50% of main longitudinal reinforcing steel embedded in sound concrete. • Severe loss of section on main bars or stamp bends (greater than 20%)	• Wide or growing (reduce by one if wide longitudinal crack or spall within AZ)	• Wide flexural cracks. • End diaphragm spall extending into legs.
1			

Table 7.4 – Rating Guide – Standard reinforced concrete girders

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Rating Guide - Standard Reinforced Concrete Girders

Notes for Table 7.4:

- Reduce as needed to reflect condition and functionality of structure.
- Longitudinal crack or spall rating of type PA or PG girders is eligible for a one rating point increase.
- Longitudinal crack or spall rating of type HC, HH, PE, or VH girders is eligible for a one rating point increase if limited to a single leg only, and the other leg of the girder is free of longitudinal cracks or spalls.
- If defects listed are limited to curb girder only the ratings can be raised by one to reflect the lower live load carrying function of this unit as discussed in section 7.15.2.7.

Cracks Widths:

- Hairline	Less than 0.1 mm
- Narrow	0.1 mm to less than 0.3 mm
- Medium	0.3 mm to less than 1.0 mm
- Wide	Equal to or greater than 1.0 mm

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Spall in AZ with <50% of bars embedded in sound concrete – Rated 2.



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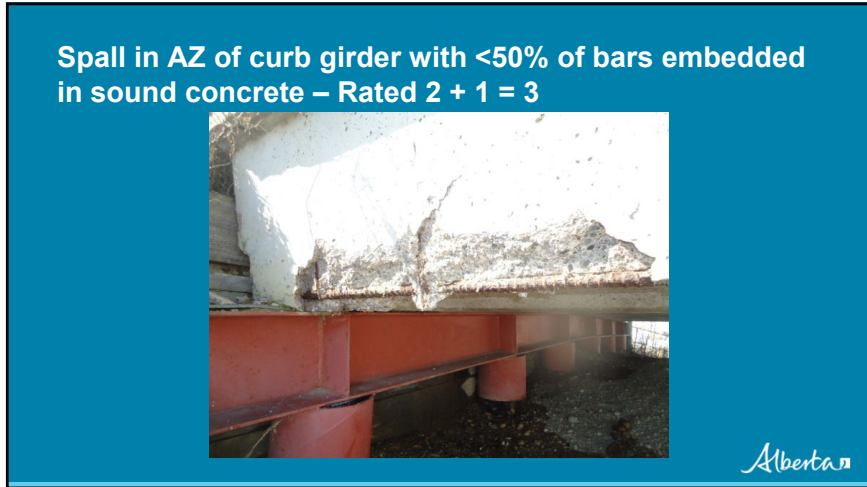
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Spall in AZ with <50% of bars embedded in sound concrete – Rated 2.

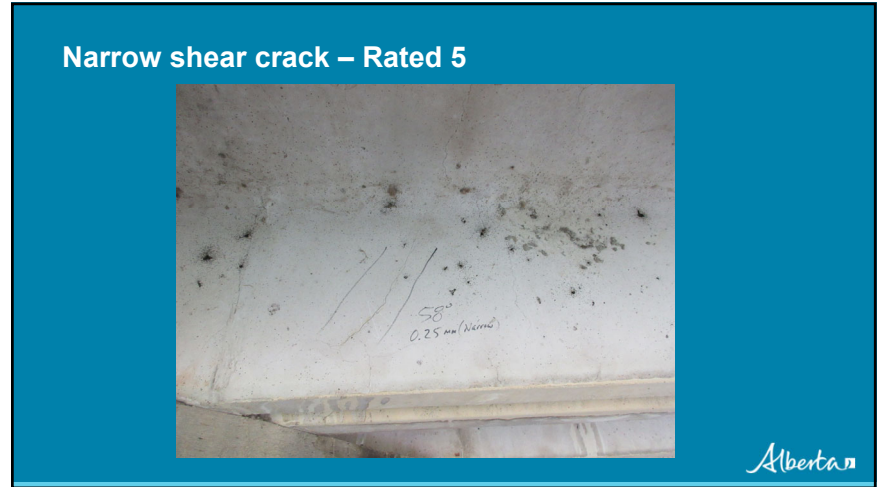


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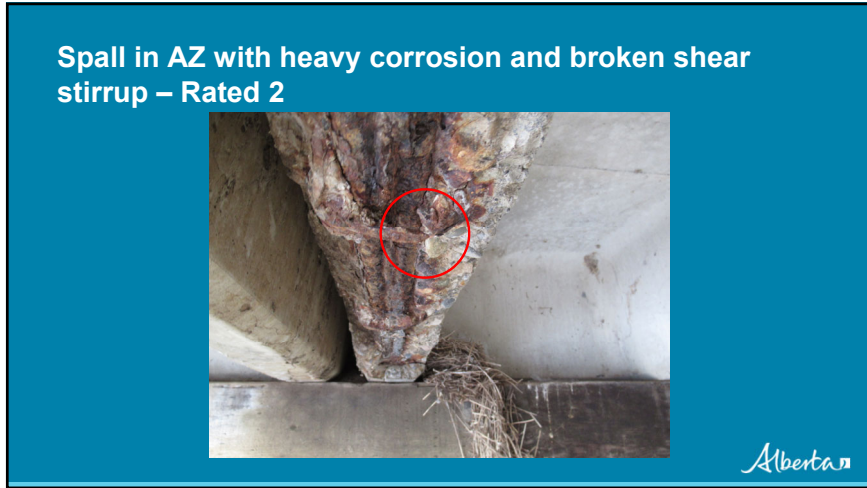
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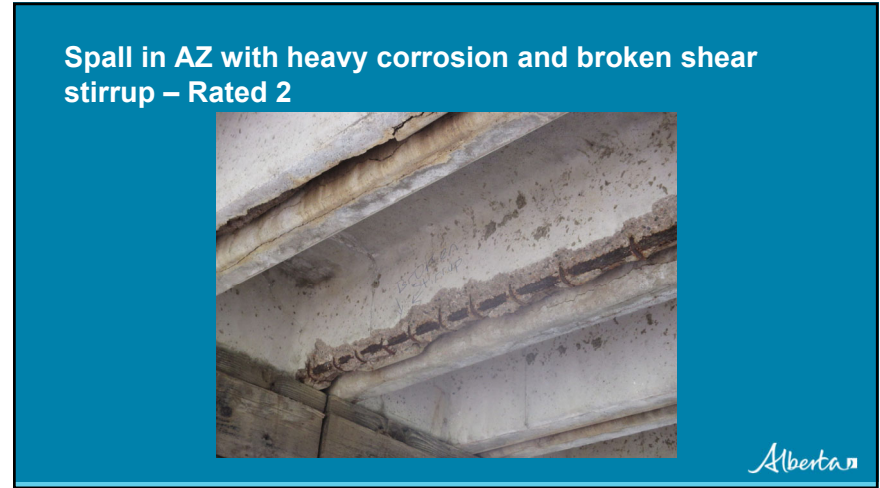
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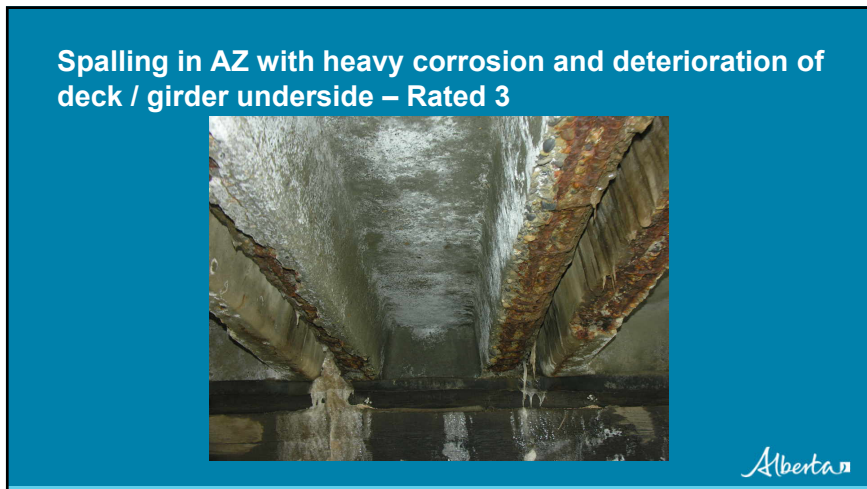
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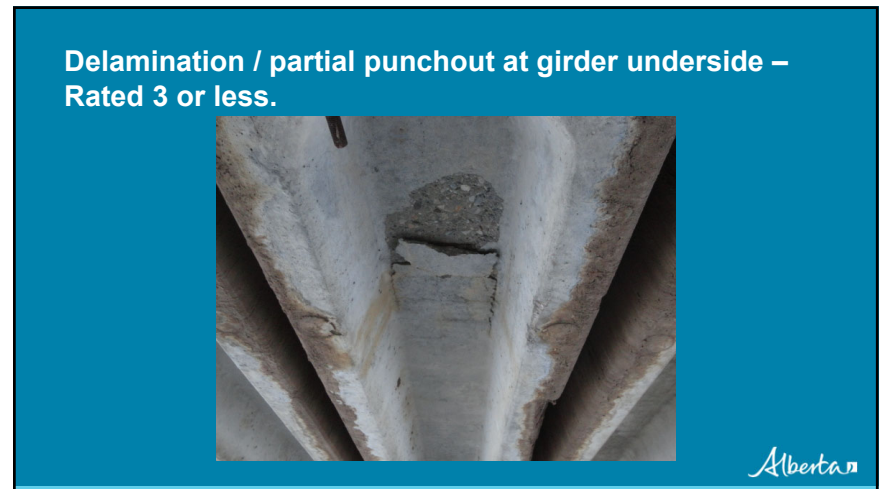
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Full depth punchouts at girder underside – Rated 3 or less.



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Rating Pre-stressed Girders

- Refer to Sections 7.14 to 7.14.3 for general information.
- Refer to Section 7.15.4 to 7.15.4.3 for specific information.
- Summarized in Tables 7.5, 7.6, and 7.9
- Suggest using “3-strike” rule to determine ratings for pre-stressed girders.

1. Start with Table 7.9 – Exception List for common *standard* prestressed girder types (VS, SM, SC, SL).
 - Note that crack width must be narrow – reduce by 1 if corrosion staining is present.
 - If defect in field matches description in Table 7.9 then rate accordingly.
2. Refer to Table 7.6 – Exception List for ALL Pre-stressed Girders.
 - If defect in field matches description in Table 7.4 then rate accordingly.
3. Refer to Table 7.5 – rate accordingly

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Rating Guide for Prestressed Girders – Table 7.9
Exception List - SL, SC, SM, VS

Crack	Rating	Description
1	5	Diagonal crack on bottom of girder, not longer than 0.5 m. Crack length must be continuous and not intermittent or staggered. Crack lengths to be measured from the face of the pier cap or abutment seat and along the length of the crack (with no signs of corrosion staining).
	3	Diagonal crack on bottom of girder, not longer than 0.5 m. Crack length must be continuous and not intermittent or staggered. Crack length to be measured from the face of the pier cap or abutment seat and along the length of the crack (with signs of corrosion staining).
2	5	Longitudinal crack on girder underside.
3	5	Longitudinal crack at lower curb fascia.
4	5	Crack in poured connection at fascia over piers (RM, RD, SMC, SCC, SCM, SLC).

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Rating Guide Table 7.6
Exception List for ALL Prestressed Girders

Exception List - All Prestressed Girders

Crack	Rating	Description
1	6	• Narrow map cracks.
	4	• Medium, wide or any map cracking with corrosion staining.
2	3	• Vertical crack 50 to 100 mm from end of girders with or without signs of corrosion stains. No further rating reduction applied for presence of stains

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Rating Guide for Prestressed Concrete Girders – Table 7.5

Rating	Defects
4	<ul style="list-style-type: none"> Hairline cracks with no staining except as noted below.
3	<ul style="list-style-type: none"> All other cracks except as noted below. Corrosion stains originating from prestressed strands.
2	<ul style="list-style-type: none"> Cracks with signs of corrosion in webs or bottom of boxes or flanges except as noted below. Any cracks which are growing
1	<ul style="list-style-type: none"> Any cracks which are opening or closing under traffic or with slippage along the cracks.

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Typical Diagonal Cracks & Narrow Longitudinal Cracks – Rated 5



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Medium or wide longitudinal crack, no corrosion. Rated 3



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Wide longitudinal crack, no corrosion staining. Rated 3



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Wide longitudinal crack, with corrosion. Rated 2



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Narrow longitudinal crack with corrosion. Rated 4



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Narrow longitudinal crack with no corrosion. Rated 5



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Partial depth repair of prestressed box girder. Note location of strand inside of rebar.



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Minor Corrosion Spots – No Affect on Rating



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SC Girder Deterioration

- AT first learned of problem in 2012
- 6 SC girder bridges showing signs of accelerated freeze thaw deterioration on exterior girders.
- Investigation revealed deterioration due to substandard aggregates in concrete mixes used in girders fabricated 2003-2007
- 88 SC girder bridges built in this time frame
- 36 of 88 bridges now showing deterioration with various degrees of severity.
- 16 - significant premature deterioration
- 20 - deterioration may soon become severe
- Severe deterioration typically on exteriors especially if exposed to direct sunlight but interior girders are also affected

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SC Girder Deterioration

- Issues include:
- failure of the concrete plinth where bridgerail post anchors into exterior girder,
- reduced structural capacity of the exterior girders due to loss of concrete and reinforcing steel embedment,
- signs that damage to the tops of girders may soon become a concern for sites with no wearing surface.

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SC Girder Deterioration Ratings

Defect	Rating	Description
1.	4	Aggregate popouts, light scaling and other signs of freeze thaw damage with no visible signs of concrete section loss.
2.	3	Concrete section loss of the side face of the girder that does not extend more than 50 mm from the top or bottom edges of girder.
	2	Concrete section loss on the side face of the girder that extends more than 50 mm from the top or bottom edges of girder.
3.	3	Concrete section loss of the side and/or end face of the girder that does not extend more than 50 mm from the vertical edge of the girder ends.
	2	Concrete section loss of the side and/or end face of the girder that extends more than 50 mm from the vertical edge of the girder ends.
4.	3	Concrete section loss of the girder top surface less than 35 mm in depth.
	2	Concrete section loss of the girder top surface more than 35 mm in depth.
5.	2	Exposed steel stirrups.
6.	2	Exposed prestressing strands.

Table 7.11 – Exception list – Girder type: SC

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SC Girder Deterioration

Extensive scaling exterior girder surfaces , section loss along top and bottom corners.

No exposed stirrups or prestressing strand.

Section loss of Bridgerail post plinth.

Girder rated 3.

BR posts rated 3.



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SC Girder Deterioration

Section loss along top and bottom corners of exterior girder.

Girder rated 3.

Bridgerail posts rated 3.



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SC Girder Deterioration

Section loss along top corners and top surfaces of interior girders.

Interior girders rated 3.



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SC Girder Deterioration

Significant section loss all surfaces extending beneath bridgerail post baseplate.

Exposed stirrups.

Exterior girder rated 2.

Bridgerail posts rated 2.



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SC Girder Deterioration



Scaling of exterior face, section loss on top and bottom corners extending beneath the bridgerail post bases.
 No exposed strands or stirrups.
 Exterior girder rated 3.
 Bridgerail posts rated 2.

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SC Girder Deterioration



Section loss at top corner of exterior girder that does not extend to the edge of the bridgerail post base plate.

Aggregate popouts on exterior face.

Concrete section loss of bridgerail plinth.

Girder rated 3.

Bridgerail post rated 3.

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SC Girder Deterioration – Management Strategy

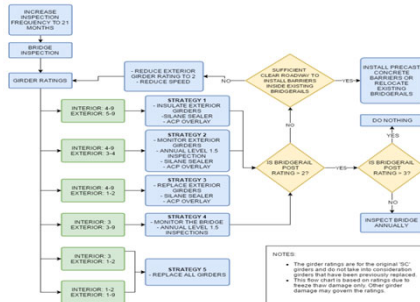


Figure 11.1 – Management strategy flowchart for SC girders showing signs of accelerated freeze-thaw deterioration

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Span Alignment Problems

- Applies only to
 - the vertical and horizontal alignment of the superstructure
- No rating is required
- Mis-alignments may indicate distress in the superstructure and/or substructure

Bridge Component	Superstructure		
	Last	Now	Explanation of Condition

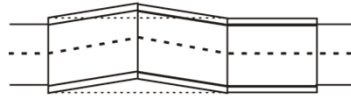
Span Alignment Problems			
Vertical (Y/N)			
Horizontal (Y/N)			

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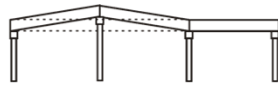


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Span Alignment Problems



Horizontal Misalignment



Vertical Misalignment

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Span Alignment Problems

- Look along edges of girders, curbs, railing for signs of sags, bows, movement, buckling, twisting, etc.
- Look for vertical mis-alignment and uneven gaps at deck joints
- Indicate vertical and horizontal alignment problem by Yes or No
- If Yes, provide an explanation of the location, type, possible cause and seriousness

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Span Alignment Problem - Vertical



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Span Alignment Problem - Horizontal



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General Rating

- Refer to Sections 1.10.2 and
- Governed by
 - Structural load carrying members (girders, stringers, subdeck)
 - Safety concerns rated 2 or less (e.g. missing bridle rail, severe bump, severe span alignment problem)
 - Hazardous conditions rate 2 or less (e.g. ponding/icing, wide ACP cracks/ruts in wheelpath)
- Bridle rail not present (rated X) but creating a hazard results in General Rating of 2

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Questions?



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