

MAJOR SUPERSTRUCTURE INSPECTION & RATING

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1

Wearing Surface

- Bonded or fastened to the deck
- In direct contact with the traffic
- Not part of the "structural" deck
- Purpose
 - Protects the bridge deck
 - traffic wear
 - salt and water infiltration
 - Provides a smooth wearing surface
 - Provides skid resistance

2

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2

Wearing Surface

- Types
 - Asphalt
 - Current standard is 2 - 40 mm lifts and 10 mm waterproofing membrane
 - Timber
 - untreated
 - Treated
 - Polymer membranes
- Concrete overlay
 - silica fume
 - high density
 - latex modified
 - other (Pyrament)
 - fiber reinforced
- Others
 - Steel grating
- May have more than one type
 - i.e. polymer membrane on concrete overlay

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3

3

Wearing Surface

- Drive over deck at design or posted speed
- Observe traffic crossing bridge
 - Look for deflections or movement
 - Listen for unusual noises
- Look for defects common to the material
- Look for debonding, loosening or loss of wearing surface
 - Sound for debonding using hammer if suspected
- Look for protruding nails in timber wearing surfaces
- Look for loss of aggregate from polymer wearing surfaces or seal coats
- Look for polishing of concrete overlays especially high density

4

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4

Wearing Surface

Wearing Surface/Deck Top Detail Ratings				
Level	N (%)	1 (%)	2 (%)	3 (%)
None				
Wearing Surface/Deck Top (Material Type :)				
(Pavement Thicknesses) :)				
(Pavement Widths) :)				
• TT, TH and PT forms				
Wearing Surface/Deck Top Detail Ratings				
Level	N (%)	1 (%)	2 (%)	3 (%)
None				
Wearing Surface (Material Type :)				
(Thicknesses) :)				
Lateral Connection Problem (Yes)				
PCS and PSR only				
• PCS, PSR, SG, SS, DT and CON forms				

5

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5

Wearing Surface

- Record or verify type
- Record or verify
 - Thickness (design curb heights can be found in table 7.2)
 - Size (TH & PT only)
- Record or verify the presence of Lateral Connection Problem (Y/N)
 - PSR and PCS only
 - Rate under girders
- If no wearing surface, rating is for Deck Top
 - TH, PT and TT only

6

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6

Wearing Surface

- Record in *Explanation of Condition* location, severity and extent of
 - Wear
 - Scaling / raveling
 - Cracks
 - Debonding
 - Wearing surface loss

7

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7

Wearing Surface

- Rate according to existing condition and functionality
- If wearing surface does not have sufficient skid resistance
 - rate 4 or less
- If wearing surface does not cover the entire deck (curb to curb) and the condition creates a possible wheel trap
 - rate 4 or less
 - rate 2 if traffic hazard
- Exposed nails or other fasteners
 - rate 4 or less
- Speed reduced due to potholes, missing planks, ruts or other deterioration
 - rate 4 or less

8

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8

Wearing Surface

- Asphalt wearing surface
 - longitudinal or transverse cracks - rate 7 or less
 - cracks with edges raveling – rate 4 or less
 - rutting rate 4 or less
 - potholes or debonding (difficult to determine on Level 1) – rate 4 or less
- Concrete to Grade or Concrete Overlay wearing surface
 - narrow cracks - rate 5
 - Wide cracks - rate 4 or less
 - Severe scaling exposed aggregate, spalling or debonding – rate 3 or less

9



9

Wearing Surface

Rating	Scaling	Crack Frequency	Delaminated Areas	Spalled & Patched Areas
7		HN ≤ 1/30 mm ²		
6		HN ≤ 1/10 mm ² MW ≤ 1/30 mm ²	≤ 1%	
5	Light	HN ≤ 1/3 mm ² MW ≤ 1/10 mm ²	≤ 3%	
4	Moderate	HN ≤ 1/1 mm ² MW ≤ 1/3 mm ²	≤ 10%	≤ 1%
3	Heavy	HN > 1/1 mm ² MW ≤ 1/1 mm ²	≤ 30%	≤ 3%
2	Severe	MW > 1/1 mm ²	> 30%	> 3%

Table 2.5 – Concrete overlay rating guide

- Crack definitions
 - Hairlines <0.1 mm
 - Narrow ≥0.1 mm and <0.3 mm
 - Medium ≥0.3 mm and <1.0 mm
 - Wide ≥1.0 mm

Note: Table is from Level 2 Manual

10



10

Wearing Surface

Rating	Severity	Flushing	Rutting and Surface Distortions	Skid Resistance (SKM Number)	Longitudinal, Transverse, Random Cracks	Lost Area (%) Potholes & Patches	Debond (%)
6					≤ 1/30 mm ²		≤ 1
5	Light	Variable colouring, localised weining	< 10 mm	40-50	≤ 1/10 mm ²	≤ 1	≤ 3
4	Moderate	Distinct colour with free asphalt	10-25 mm	30-40	≤ 1/3 mm ²	≤ 3	≤ 10
3	Heavy	Wet look & tire noise. Traffic leaves tire impressions	25-50 mm	20-30	≤ 1/1 mm ²	≤ 10	≤ 30
2	Severe	Excess free asphalt with wet look. Feet leave impressions	> 50 mm	< 20	> 1/1 mm ²	> 10	> 30

Table 2.3 – ACP wearing surface rating guide (1 of 2)

Note: Table is from Level 2 Manual

11



11

Wearing Surface

Rating	Severity	Ravelling	Cracking
5	Light	Noticeable loss of material	1+ cracks < 10 mm width. Alligator pattern establishing, numerous interconnecting cracks. 1 or 2 edge cracks within 600 mm of edge.
4	Moderate	Shallow disintegration of surface with open textured appearance	1+ cracks 10-20 mm width. Alligator pattern established with corners of polygons fracturing. Multiple edge cracks within 900 mm of edge.
3	Heavy	Shallow disintegration of surface, small potholes. Open texture loose surface materials	1+ cracks 20-30 mm width. Alligator pattern established with spalling of polygon blocks. Multiple edge cracks within 1200 mm of edge with alligator cracking along edges.
2	Severe	Deep surface disintegration many potholes. Very open texture with loose surface materials	1+ cracks > 30 mm width. Alligator cracking with polygon blocks lifting, creating potholes. Multiple edge cracks over 1200 mm of edge with alligator cracking along edges.

Table 2.4 – ACP wearing surface rating guide (2 of 2)

Note: Table is from Level 2 Manual

12



12

Wearing Surface

Rating	Polymer Debond / Lost Area	Seal Coat Lost Area	Polymer Cracking	Slipperiness
7		≤ 1%		
6	≤ 1%	≤ 3%	≤ 1/30 m/m ²	
5	≤ 3%	≤ 10%	≤ 1/10 m/m ²	Light
4	≤ 10%	≤ 30%	≤ 1/3 m/m ²	Moderate
3	≤ 30%	> 30%	≤ 1/1 m/m ²	Heavy
2	> 30%		> 1/1 m/m ²	Severe

Table 2.2 – Polymer and seal coat wearing surface rating guide

Note: Table is from [Level 2 Manual](#)

13



13

Deck Drainage

- Not included on TT, PT or TH forms
- Poor drainage
 - Common cause of deck deterioration
 - May cause a hazard due to hydroplaning or icing
 - Caused by inadequate design, construction or maintenance practices
 - May affect other bridge elements
 - superstructure
 - substructure
 - head slopes and sideslopes

14



14

Deck Drainage

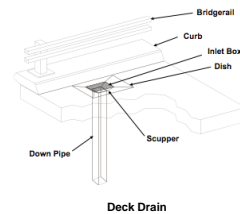
- Drainage system includes
 - gutters, inlet boxes, scuppers, downpipes and catch basins
 - drainage problems at deck joints
 - sealed
 - with plumbing
 - non-watertight

15



15

Deck Drainage

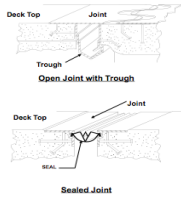


16



16

Deck Drainage



17

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17

Deck Drainage

- Check drainage systems for:
 - plugging of inlet boxes, scuppers, downpipes and joint plumbing
 - corrosion of metal components
 - gouges, cracks, breaks or tears
 - joint seals
 - integrity of attachments and connections
 - loose or missing bolts
 - cracked or broken welds
 - loose or open connections
 - length of downpipes

18

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18

Deck Drainage

- Check for:
 - signs of ponding on the deck
 - damage to the deck, curbs, girders and substructure
 - staining (water and rebar corrosion)
 - scaling
 - freeze-thaw
 - delaminations
 - spalling
 - erosion below downpipe

19

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19

Deck Drainage

Deck Drainage			
Drains Clogged (Y/N)			

- Record or verify if drains or joint plumbing is clogged

20

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20

Deck Drainage

- For timber decks or steel grating rate X
 - not on TT, TH & PT forms
- Water ponded on the deck rate 4 or less
- Ponding water is a hazard rate 2
- Drains leak or downpipes too short rate 4 or less
- Ponding, leakage or discharge causes significant deterioration of deck, curbs, girders or substructure rate 3 or less
- Erosion on sideslopes or headslopes from discharge rate 4 or less
- Deck joint leakage causing damage - reduce rating

21

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21

Deck Top/ Underside

- Purpose
 - Carries traffic loads
 - Transfers loads to main structural members
 - Can be in direct contact with traffic in the absence of a wearing surface
- Types
 - Cast in place concrete
 - Precast concrete
 - Timber
 - Steel grate
- Separate ratings for top and underside
 - Except for PCS, rate underside with top and girders
- May not be inspectable from the top
 - Wearing surface
 - Snow, ice or gravel

22

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22

Deck Top/ Underside

- Drive over deck at design or posted speed
- Observe deck under traffic
 - Listen for unusual noises
 - Look for deflections or movement
- Look over deck top and underside for problems with material
- On concrete decks, sound suspect areas with a hammer to detect delaminations
 - Birdbath locations
 - Stained areas
 - Badly cracked areas or adjacent to large cracks

23

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23

Deck Top/ Underside

- Deck Top rated separately except for PT, TH and TT where Wearing Surface / Deck Top combined

Sub Deck/Deck Underside	
(Material Type :)	
(Plank Thickness (mm) :)	
(Plank Width (mm) :)	
Defects (Percent Area)	

- Applies to PT, TH and TT only

Deck Underside	
(Material Type :)	
(Plank Thickness (mm) :)	
(Plank Width (mm) :)	
Defects (Percent Area)	
(Snow, Ice Filled :)	

Applies to DT and SS only

- Remainder applies to SG, PSR, CON, DT and SS

24

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24

Deck Top/ Underside

- Record or verify subdeck type and size for TH, PT& TT
- Record or verify deck underside
 - % defects for TH, PT & TT
 - % stains for all others
- Record if snow slots filled for DT & SS
- Record location, severity and extent of
 - Staining
 - Scaling
 - Cracks
 - Delaminations
 - Spalling

25



25

Deck Top / Underside

- Rate according to existing condition and functionality
- Speed reduced due to deterioration
 - rate 4 or less
- Surface does not have sufficient skid resistance
 - rate 4 or less
- Steel grating
 - connections are loose or broken rate 4 or less
 - improper bearing or support on girders rate 4 or less
- Timber
 - minor splitting in non-adjacent planks - rate 5 or more
 - any rot - rate 4 or less
 - broken planks - rate 4 or less
 - connections loose or broken - rate 4 or less

26



26

Deck Underside

- Box or voided girder units (e.g. PM, VM, RD, RM) deck underside is not directly visible but is considered as deck underside and rated accordingly
 - rating would govern girder rating if no top side defects
- Concrete deck underside with Minor crack and stains – rate 5
- Spalling, severe scaling (exposed aggregate)/>25 mm deep – rate 4 or less

27



27

Deck Underside

Rating	Scaling	Crack Frequency	Delaminated Areas	Spalled & Patched Areas	Underside Staining
7		HN ≤ 1/30 m/m ²			
6		HN ≤ 1/10 m/m ² MW ≤ 1/30 m/m ²			
5	Light	HN ≤ 1/3 m/m ² MW ≤ 1/10 m/m ²	≤ 1%		Light
4	Moderate	HN ≤ 1/1 m/m ² MW ≤ 1/3 m/m ²	≤ 3%	≤ 1%	Moderate
3	Heavy	HN > 1/1 m/m ² MW ≤ 1/1 m/m ²	≤ 10%	≤ 3%	Heavy
2	Severe	MW > 1/1 m/m ²	> 10%	> 3%	Severe

Table 2.6 – Concrete deck rating guide

- Crack definitions
 - Hairline <0.1 mm
 - Narrow ≥0.1 mm and <0.3 mm
 - Medium ≥0.3 mm and <1.0 mm
 - Wide ≥1.0 mm

Note: Table is from Level 2 Manual

28



28

Deck Underside

Concrete Staining Deck Rating Guide

Severity Rating	Description
5	Efflorescence or exudation at cracks. Light grey damp appearance
4	Dark grey damp appearance
3	Efflorescence or exudation in saturated areas Light rust stains
2	Heavy rust stains

29

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29

Concrete Girders

- Purpose
 - Receive the loads from the deck
 - Transmit the loads to the substructure (through the bearings)
- Three types
 - Cast-in-place standard reinforced
 - Standard reinforced precast
 - Prestressed or post-tensioned precast

30

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30

Concrete Girders

- Inspection is primarily visual, looking for
 - Staining
 - Scaling
 - Cracks
 - Delamination's
 - Spalling
- Observe girders under traffic and look for unusual deflections or movement
 - Independent movement on laterally connected girders

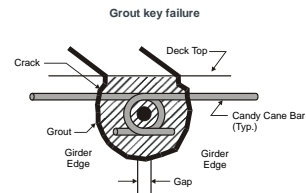
- Evidence of grout key or lateral connection failure
 - Cracking or loss of grout in grout key
 - Cracking in pavement
 - Corrosion, or missing, loose or broken bolts at channel connectors
 - staining on underside of keys

31

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31

Concrete Girders



32

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32

Concrete Girders

- On post-tensioned girders check end anchorage zones
- Check for corrosion of prestressing or post-tensioning cables
 - rust stains or cracking along sides of girders
 - leakage onto ends of girders with staining from ends of cables
- Cracking in end anchorage zone of prestressed girders
- High load damage which breaks the concrete around the pre- or post-stressed cables
 - Look for damaged or broken cables

33

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33

Concrete Girders

Girders		
Cracking (Y/N)		
Spalling (Percent Area)		

- Record or verify the presence of cracking
 - PCS, PSR & CON
 - Not hairline/narrow flexural on PCS or CON
- Record or verify the amount of spalling in %
 - PCS and PSR
 - Corrosion induced spalling on bottoms and sides over stirrups only
 - % of total leg or girder length
- Girder Detail Ratings on PCS forms only

34

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34

Concrete Girders

- Record in *Explanation of Condition* location, severity and extent of
 - Staining
 - Scaling
 - Cracks
 - Delamination's
 - Spalling
 - Grout Key failure

35

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35

Plain Reinforced Concrete Girder Rating

- Applies to all plain reinforced concrete girders
 - Not prestressed or post-tensioned
- If curb girder **only** affected, can increase ratings by one
 - Applicable only if girder does not carry direct wheel load
 - Has lower load carrying function
 - Does not apply to shear cracks

36

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36

Plain Reinforced Concrete Girder Rating Guide

Rating	Spalling or Longitudinal Cracks on Legs	Shear cracks (not greater than 60° from horizontal)	Other Defects
5 No effect			<ul style="list-style-type: none"> Narrow flexural cracks Isolated end diaphragm spall Narrow map cracks
4	<ul style="list-style-type: none"> Medium crack within AZ with sound concrete (must be accessible and confirmed by inspector) Wide crack outside AZ with sound concrete 	<ul style="list-style-type: none"> Narrow (reduce by one if wide longitudinal crack or spall within AZ) 	<ul style="list-style-type: none"> Top slab transverse crack
3	<ul style="list-style-type: none"> 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 stirrup bends (up to 10%) 	<ul style="list-style-type: none"> Medium (reduce by one if wide longitudinal crack or spall within AZ) 	<ul style="list-style-type: none"> 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 Spalling length less than 150 mm (rule it or less)
2	<ul style="list-style-type: none"> 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 Spall within AZ with less than 50% of main longitudinal reinforcing steel embedded in sound concrete Severe loss of section on main bars or stirrup bends (greater than 20%) 	<ul style="list-style-type: none"> Wide or growing (reduce by one if wide longitudinal crack or spall within AZ) 	<ul style="list-style-type: none"> Other punchouts Medium or wide concrete grout key cracks Failed girder connectors Spalling length less than 75 mm (rule it or less) Wide flexural cracks End diaphragm spall extending into legs
1			

Table 7.4 - Rating Guide - Standard reinforced concrete girders



37

37

Plain Reinforced Concrete Girder Rating

Rating	Description
5	Medium crack & sound concrete – in anchor zone (AZ) Wide crack with sound concrete or spall with 50% bar embedment - outside anchor zone
4	Medium crack in unsound concrete - anchor zone Wide crack in sound concrete – anchor zone Wide crack unsound concrete or soundness not confirmed, spall <50% outside AZ
4	Moderate section loss on main bars or stirrup bends up to 10%
3	Wide cracks in unsound concrete or spall ≥50% main bar embedment in AZ
2	Spall with <50% of main bar embedded in sound concrete – anchor zone
2	Severe loss of section on main bars or stirrup bends greater than 20%

38



38

Plain Reinforced Concrete Girder Rating

Shear Cracks

*Must be 60 degrees or less from horizontal

RATING DESCRIPTION

- 5 Narrow*
- 3 Medium*
- 2 Wide or growing*

*Reduce by one if wide longitudinal crack or spall in anchorage zone

39



39

Plain Reinforced Concrete Girder Rating

Other Defects

Rating	Description
	No effect Hairline or narrow flexural cracks
6	Isolated end diaphragm spall Narrow map cracks
5	Top slab transverse crack
4	Medium or wide map cracking or any map cracking with staining
4	Medium flexural or narrow grout key cracks
4	Small punchouts (≤150 mm diameter)

40



40

Plain Reinforced Concrete Girder Rating

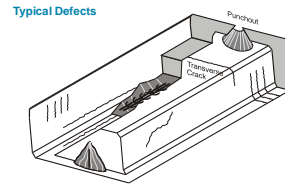
Rating	Description
4	Bearing length less than 100 mm
3	Medium or wide grout key cracks
3	Other punchouts
3	Failed girder connectors
3	Bearing length less than 75 mm
2	Wide flexural cracks
2	End diaphragm spall extending into legs

41



41

Plain Reinforced Concrete Girder Rating



42



42

Prestressed Concrete Girder Rating

- Applies to all prestressed and post-tensioned concrete girders
- Reduce as needed to reflect condition & function
- If curb girder only affected, can increase ratings by one
 - Applicable only if girder does not carry direct wheel load
 - Has lower load carrying function
 - Does not apply to shear cracks
 - **Does not apply** to any "Major concrete structure types" listed in Table 7.1

43



43

Prestressed Concrete Girder Rating

7.15.4.4. Rating Guide for Prestressed Concrete Girders

Rating	Defects
4	<ul style="list-style-type: none"> • Hairline cracks with no corrosion staining except as noted in 'Exception Lists'. • Standard prestressed girders with a bearing length less than 100 mm - rate 4 or less.
3	<ul style="list-style-type: none"> • All other cracks except as noted in 'Exception Lists'. • Corrosion stains suspected to be originating from prestressing strands. • Standard prestressed girders with a bearing length less than 75 mm - rate 3 or less.
2	<ul style="list-style-type: none"> • Cracks with signs of corrosion in webs or bottoms of boxes or flanges except as noted in 'Exception Lists'. • 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.

Table 7.5 – Rating guide for prestressed concrete girders

44



44

Prestressed Concrete Girder Rating

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

Table 7.6 – Exceptions list – All prestressed girders

For the following typical cracks and defects in Table 7.7 through Table 7.12, unless noted otherwise:

- Crack width assumed as **narrow**
- Reduce rating by 1 point with presence of corrosion staining

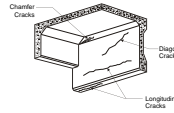
45

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45

Prestressed Concrete Girder Rating

Type FC, FM, LF, VF



Defect	Rating	Description
1.	5	Narrow crack in chamfer between web and flange. May extend into deck underside or web. Generally found near girder end but may also extend to first diaphragm location.
	4	Medium or wide crack in chamfer between web and flange. May extend into deck underside or web. Generally found near girder end but may also extend to first diaphragm location.
2.	5	Hairline or narrow longitudinal crack in bottom half of web at girder end.
	4	Medium or wide longitudinal crack in bottom half of web at girder end.
3.	5	Hairline or narrow longitudinal crack at underside of girder lag at girder end.
	4	Medium or wide longitudinal crack at underside of girder lag at girder end.
4.	5	Diagonal crack in the transition and wide web section of the web at girder end (reduce by 1 if extending into top flange or extending into narrow web section).
	4	Diagonal crack in the transition and wide web section of the web at girder end (reduce by 1 if extending into top flange or extending into narrow web section).

Table 7.7 – Exception list – Girder type: FC, FM, LF, VF

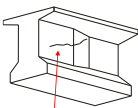
46

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46

Prestressed Concrete Girder Rating

Type CBC, CBT, DBC, DBT



Crack in girder end block through transition zone

Defect	Rating	Description
1.	5	Diagonal crack in the transition and wide web section of the web at girder end (reduce by 1 if extending into top flange or extending into narrow web section).

Table 7.8 – Exception list – Girder type: CBC, CBT, DBC, DBT

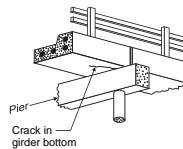
47

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47

Prestressed Concrete Girder Rating

Type PB, PM, RD, RM, SC, SL, SM, VM, VS



Defect	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 lengths 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).
	4	Crack in poured connection at fascia over piers (RM, RD, SMC, SCC, SCM, SLC).

Table 7.9 – Exception list – Girder type: PB, PM, RD, RM, SC, SL, SM, VM, VS

48

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48

Prestressed Concrete Girder Rating

Type NU – Horizontal or Radial End Zone Cracks

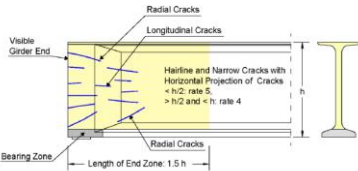


Figure 7.88 – Horizontal or radial end zone cracks in NU girder webs with exposed ends and end blocks

53



53

Prestressed Concrete Girder Rating

Type NU – Horizontal or Radial End Zone Cracks

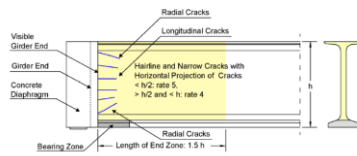


Figure 7.89 – Horizontal or radial end zone cracks in NU girder webs with ends encased in concrete diaphragms

54



54

Prestressed Concrete Girder Rating

Type NU – Potential Shear Cracks

Defect	Rating	Description
2.	4 or less	Hairline diagonal cracks that extend over a horizontal or vertical projection larger than half the girder depth ($h/2$) with an angle θ between 25° and 60° as shown in Figure 7.90 (potential shear cracks).
	3 or less	Narrow or wider diagonal cracks that extend over a horizontal or vertical projection larger than half the girder depth ($h/2$) with an angle θ between 25° and 60° as shown in Figure 7.90 (potential shear cracks).

Note: The lower angle limit for shear cracks in NU girders is less than in other girders (25° vs. 30°) because shear cracks in highly prestressed girders are known to be flatter.

55



55

Prestressed Concrete Girder Rating

Type NU – Potential Shear Cracks

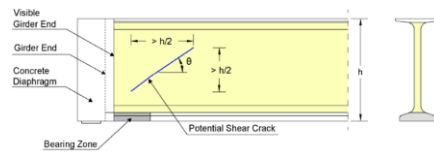


Figure 7.90 – Potential shear cracks in NU girders

56



56

Prestressed Concrete Girder Rating Type NU – Horizontal Web Cracks

Defect	Rating	Description
3.	5	Hairline or narrow horizontal cracks along post-tensioning ducts in the girder webs or the top flange-to-web or bottom flange-to-web transition radii that are shorter than half the girder depth ($h/2$) and without signs of white efflorescence or corrosion staining as shown in Figure 7.91.
	4	Hairline or narrow horizontal cracks along post-tensioning ducts in the girder webs or the top flange-to-web or bottom flange-to-web transition radii that are longer than half the girder depth ($h/2$) and shorter than five times the girder depth ($5h$) and without signs of white efflorescence or corrosion staining as shown in Figure 7.91.
4.	3 or less	Cracks initiated by grout vents or horizontal web cracks along post-tensioning ducts with signs of moisture resulting in efflorescence.
	2 or less	Cracks initiated by grout vents or horizontal web cracks along post-tensioning ducts with signs of corrosion staining.

57

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57

Prestressed Concrete Girder Rating Type NU – Horizontal Web Cracks

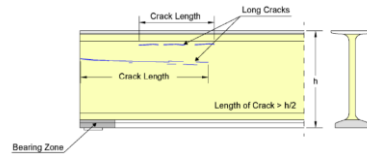


Figure 7.91 – Longitudinal horizontal cracks in NU girders

58

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58

Prestressed Concrete Girder Rating Type NU – Vertical Web Cracks

Defect	Rating	Description
5.	5	Hairline vertical cracks in girder webs adjacent to cast-in-place diaphragms that are shorter than half the girder depth ($h/2$) as shown in Figure 7.92.
	4	Narrow vertical cracks in girder webs adjacent to cast-in-place diaphragms that are shorter than or half the girder depth ($h/2$) as shown in Figure 7.92.

59

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59

Prestressed Concrete Girder Rating Type NU – Vertical Web Cracks

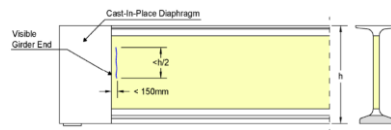


Figure 7.92 – Vertical cracks in NU girders adjacent to C.I.P. diaphragm

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60

Prestressed Concrete Girder Rating Type NU – Cracks in Girder Splices and Closure Pours

Defect	Rating	Description
6.	5	Hairline cracks in splices / closure pours between NU girder ends or at the interface between girder end and grout with a length smaller than half the girder depth ($h/2$) (Figure 7.93).
	4	Narrow cracks in splices / closure pours between NU girder ends or at the interface between girder end and grout with a length smaller than half the girder depth ($h/2$) (Figure 7.93).

61

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61

Prestressed Concrete Girder Rating Type NU – Cracks in Girder Splices and Closure Pours

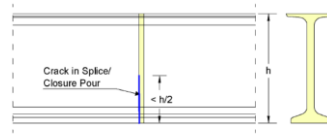


Figure 7.93 – Cracks in NU girder splices and closure pours

62

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62

Prestressed Concrete Girder Rating Type NU – Cracks at Stress Raisers

Defect	Rating	Description
7.	5	Hairline or narrow cracks in the girder webs or in the top flange-to-web or bottom flange-to-web transition radii initiated by stress raisers such as lifting holes, grout vents or embedded steel pieces for steel diaphragms and that are shorter than 500 mm (Figure 7.94).

63

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63

Prestressed Concrete Girder Rating Type NU – Cracks at Stress Raisers

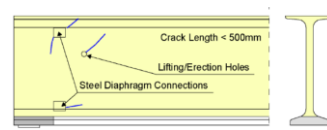


Figure 7.94 – Cracks at stress raisers in NU girders

64

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64

NU Girder – End Cast into Diaphragm



65

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65

NU Girder – with End Block



66

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66

NU Girder – with No End Block

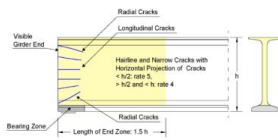


Figure 7.87 – Horizontal or radial end zone cracks in NU girder webs with exposed ends and no end blocks. Girder depth (h) range from 1200 mm to 2800 mm with depth increment of 400 mm

67

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67

Cast in Place Concrete Superstructures Section 7.15.5

- Cast-in-place (CIP) concrete superstructures found in a variety of configurations including flat slabs, slab and beam, box sections, frames, and arches.
- All configurations can be conventionally reinforced or post-tensioned.
- The sheer variety of configurations makes it very difficult to provide guidance on every possible scenario; however the following general guidelines should be used to guide the inspector's ratings

68

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68

Cast in Place Concrete Superstructures

CIP Concrete Flat Slabs – Section 7.15.5.1

- Flat slab acts as both the bridge deck and primary longitudinal load carrying element and should be rated in all three of the deck top, deck underside and girder sections
- Deck top and underside are rated according to Section 7.5 and 7.21 of BIM manual
- Shear cracks in the deck are rated according to Section 7.15.3.3.
- Flexural cracks are rated according to Section 7.15.3.4.3.
- Flexural cracks that are localized and do not extend across more than 25% of the width of the deck, the ratings presented in Section 7.15.3.3 and/or 7.15.3.4.3 may be increased by one rating point

69

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69

Cast in Place Concrete Superstructures

CIP Concrete Beams – 7.15.5.2

- Cast-in-place concrete beams, including concrete frames, concrete tees, and concrete boxes are rated in the girder section of the form.
- Conventionally reinforced beams should be rated according to Section 7.15.3 *except* No rating increases permitted for cast-in-place beams and the anchorage zone *only* applies to the free ends of the beams. Longitudinal cast-in-place beams are often continuous over interior supports and transverse cracks in the deck or girder tops over or near the supports should be rated as flexural cracks.
- Prestressed beams should be rated according to Section 7.15.4 of the BIM manual.

70

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70

Cast in Place Concrete Superstructures

CIP Concrete Arches – 7.15.5.3

- The deck top and underside on concrete arch bridges should be rated according to Section 7.5 and Section 7.21 of the BIM manual.
- Any transverse floor beams, if present, should be included in the 'Piers / Bents – Bearing Seats / Caps' rating and rated according to Section 8.5.
- Any longitudinal beams, if present, should be rated in the girder section according to Section 7.15.5.2.
- Any bents and the arch itself should be rated under the 'Piers / Bents – Pier Shaft / Piles' section according to Section 8.8 of the BIM manual.

71

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71

Steel Girders

- Purpose
 - Receive loads from the deck
 - Transmit loads to the substructure
- Two types
 - Rolled beam
 - Welded plate girders
- Usually I-shaped
 - Web
 - Flanges
- Each part of girder rated separately

- Stiffeners
 - Vertical at bearings & along span
 - Vertical stiffeners not connected to top and/or bottom flanges can cause fatigue cracks in web at top of stiffener
 - Intersection of vertical and horizontal stiffeners susceptible to fatigue cracks or sudden fracture
 - Horizontal in high bending stress areas
- Cover plates
 - Extra plates welded to flanges to increase capacity in high bending areas

72

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Steel Girders

- Cracks
 - Tension areas
 - End of cover plates
 - Stiffeners welded to bottom flange
 - Re-entrant corners
 - Changes in section
 - Stiffener welds that cross the weld from flange to web
 - Gouges, nicks, holes, collision damage
- Buckling
 - High stress areas such as at bearings

73



73

Steel Girders

- Alignment
 - Twists, bows, bends, sags
- Corrosion
 - Top of bottom flange
 - Around connections
 - Under joints
- Connections
 - Loose or missing bolt or rivets
 - Poorly fitted connections
 - Misaligned bolt holes
 - Deformed bolt holes
 - Corrosion between plates
 - warping of plates
- Collision damage
 - Grade separations

74



74

Steel Girders

- Notches or stress raisers in tension areas
 - rate 4
- If corrosion is causing a loss of section
 - rate 4 or less
- If any signs of distortion or misalignment
 - rate 4 or less
- If fatigue cracks or signs of distortion
 - rate 4 or less
- Elements with visible cracks
 - rate 3 or less
- Fatigue cracks in a tension flange or element
 - rate 2 or less

75



75

Diaphragms / Cross Frame

- Purpose
 - Distribute loads between girders
 - Resist torsion forces
 - Support the compression flange of the girder
- Generally made out of the same material as the girder
 - If not, usually steel
- Rate according to condition and ability to function as designed
- If diaphragms contribute to defects in the girder - rate 4 or less

76



76

Steel Truss Members

- Purpose of truss as a unit is to:
 - Receive loads from deck
 - Transmit loads to substructure (through bearings)
- Three types of trusses
 - Through
 - Pony
 - Deck
- Member types are rated separately
- Includes stringers and floor beams
- Truss members in tension or compression
 - Inspector must identify each
 - Different concerns

77



77

Steel Truss Members

- Check alignment of trusses
 - top chord alignment especially important because it is in compression
- Check for wide or high load damage
 - If any present, indicate "YES" and explain in *Explanation of Condition*
 - Especially look at portal bracing and sway bracing
- Wide or high load damage will affect the rating of the member(s) damaged
 - compression members rating are especially lowered by bends
 - tension members by cracks or nicks
- Check connections and members adjacent to damaged member

78



78

Steel Truss Members

Check each truss member in an orderly fashion

- On tension members or collision damaged members look for cracks at connections
 - crack will most often be at first bolt hole on the member side
 - light members with significant stress or stress reversal
- On compression members look for kinks or bows
- Look for welds or torch cuts
 - crack prone
- Look for fatigue prone details
 - sharp radius corners
 - notches
 - light members - especially with stress reversal
- Check which member(s) govern load capacity
 - *Allowable Load* on first page of form

79



79

Steel Truss Members

- Check each connection in an orderly fashion
 - Loose or missing bolt or rivets
 - poorly fitted connections
 - misaligned bolt holes
 - deformed bolt holes
 - corrosion between plates
 - warping of plates
- Check for Corrosion
 - Between Built up members
 - Splash zone
 - bottom chord, especially channel section

80



80

Steel Truss Members

- Distortion or misalignment on a tension member, no other defects - rate 5
- Minor misalignment or damage to cross-bracing or portal - rate 5
- Corrosion causing a loss of section - rate 4 or less
- Missing rivets or bolts – rate 4 or less
- Cracked member - rate 3 or less
 - Cracks on bottom flange of floorbeam or stringer extending into web - rate 2 or less

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Questions?

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82