

# **Engineering Standard**

## **Structures**

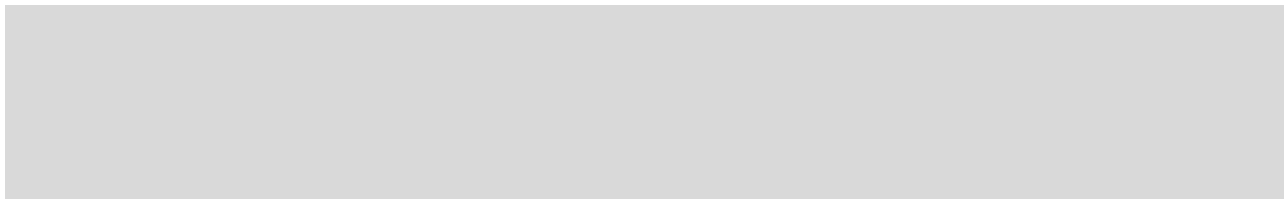
**OTCS 302**

# **STRUCTURES DEFECT LIMITS**

Version 1.0

Issued August 2018

Approved by:



## Document control

Revision	Date of Approval	Summary of change
1.0	August, 2018	First Issue. Includes content from the following former RIC standards: TS 30 000 5 04, C 3102 and CRN CS 302 Ver 1.1.

## Summary of changes from previous version

Section	Summary of change

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# 1 Purpose, scope and application

This document specifies the defect limits and mandatory responses that apply to structures.

They are intended to be observed and implemented during examinations of structures.

The frequency of examination is prescribed in OTCS 100 "Civil Technical Maintenance Plan" and associated specific Tailored Technical Maintenance Plans for major structures.

Procedures for the examination of structures are provided in OTCM 301 "Structures Examination Manual".

## 2 References

### 2.1 Australian and International Standards

Nil

### 2.2 OTHR documents

OTCS 100 - Civil Technical Maintenance Plan

OTCM 301 - Structures Examination Manual

### 2.3 Other references

Nil

### 2.4 Definitions

The following terminology is used in this Standard:

Bridge Examiner:	Person with Engineering Authority to examine and report on condition of bridges and other civil structures. This is normally the person conducting cyclic examinations but may also be specialist personnel responding to incidents etc.
Structures Superintendent:	Person with Engineering Authority to manage the condition bridges and other civil structures.
Defect:	Deterioration of a component from its original condition.
Defect Category:	Classification of a defect into a category that indicates the severity of the defect and response time recommended for continuing train operations and engineering assessment.
Repair Priority:	Time frame for the repair of a defect

## 3 Engineering authority

Inspection and assessment of structures detailed in this standard may only be undertaken by persons who have been granted appropriate Engineering Authority by the Engineering Manager.

## 4 Introduction

Structures on the rail network deteriorate over time from their „as-new“ condition, owing to loading cycles from trains, aging of materials and climatic factors such as the sun, wind, rain and salt air. Defects that develop include pipes in timber members, rusting of steel members and cracking and spalling of concrete.

Examinations are undertaken at prescribed intervals of all structures, to monitor their condition and to measure the extent of any deterioration. The results of the examinations are also used to prepare maintenance programs for the repair or replacement of components.

Defect Categories and Limits have been set to guide the bridge examiner in the appropriate level of action to be taken when examining and measuring structural members.

## 5 Defect categories

The person undertaking bridge or structure examination shall measure any defects and assign a defect category. Depending on the extent of any defects found, immediate action may need to be taken to ensure the safety of rail, road or pedestrian traffic.

The results of the examination shall be forwarded to the Structures Superintendent, who must also respond as summarised in the Table 1.

Defect Category	Bridge Examiner Response	Structures Superintendent Response
A	Immediately stop trains in the case of an underbridge, or close if an overbridge or footbridge. Advise Structures Superintendent immediately.	Assess immediately.
B	Immediately impose a 20km/hr speed restriction in the case of an underbridge. Advise Structures Superintendent immediately	Assess the same day.
	For footbridges and overbridges, the area shall be barricaded and a report provided to the Structures Superintendent the same day.	
C	Report to Structures Superintendent the same day	Assess within 24 hours.
D	Report to Structures Superintendent on the Weekly Summary of Defects Form for the appropriate action.	Assess within 7 days.
E	Record in bridge examination report.	Assess as part of bridge management process.

Table 1 - Defect Categories

Note – The use of the term “immediately” in the response requirements indicates that inspection, verification and removal of the defect is urgent and train movements are dependent on condition.

## 6 Repair priorities

### 6.1 General

An initial assessment and allocation of a Repair Priority as detailed in Table 2 shall be made by the Bridge Examiner as part of the examination process.

Code	Meaning	Application
Rm1	Repair within 1 month	Applies to Defect Categories A to D
Rm6	Repair within 6 months	Applies to Defect Categories A to D
Ry1	Repair within 1 year	Could apply to any Defect Category
Ry2	Repair within 2 years	Could apply to any Defect Category
Ry5	Repair within 5 years	Applies to Defect Category E only
Ryxx	No repair for 5 years	Applies to Defect Category E only
Mm1	Monitor monthly	Applies to Defect Categories A to D
Mm3	Monitor quarterly	Applies to Defect Categories A to D
Mm6	Monitor half yearly	Applies to Defect Categories A to D
My1	Monitor yearly	Applies to Defect Categories A to D
Axx	Assess/Inspect next inspection	Applies to Defect Category E only

Table 2 - Repair Priorities

In assigning repair priorities, considerations such as the location of the defect, importance of the affected member, the degradation rate, the effect of multiple defects and the operating environment (type, speed, density of rail, road or pedestrian traffic) need to be taken into account.

The initial response to a Repair Priority may include a risk management action such as increased monitoring, installation of temporary supports or imposition of a speed or load restriction, pending final repair. This may lead to the Repair Priority being redefined to a lower level by the Structures Superintendent, e.g. from Rm1 to Ry2.

## 6.2 Mandatory repair priorities

For all structures, some nominated defect types shall have a mandatory repair priority and those defects shall be repaired within the mandatory timeframe.

The nominated defect types are:

- Loose rivets & bolts in steel bridge members
- Missing or broken holding down bolts in bearing and bed plates
- Loose transom bolts
- Minor cracks and spalling in main members and decks in concrete bridges
- Blocked culverts.

The nominated defect types with a mandatory repair priority are detailed in Appendix 1.

## 7 Paint index

Paint indices shall be assigned for all steel bridges as part of the examination process. The indices reflect the condition of the surface coating, the order of the indices from worst to best being Paint1, Paint2 & Paint3. They are defined as follows:

- Paint Index – **Paint1**: Paint broken down throughout. Program to paint within 5 years.
- Paint Index – **Paint2**: Paint broken down locally. Patch paint as required within 2 years.
- Paint Index – **Paint3**: Paint in satisfactory condition.

## 8 Defect category limits

Appendix 1 provides a general guide to defect limits and associated actions to be taken by the Bridge Examiner.

In general, the limits and defect sizes have been set on the basis of them being located at the most highly stressed area of the member.

## 9 Structurally critical members

Structurally critical members are defined as members of a structure that are critical to the strength and safety of the structure and where failure of the member could lead to catastrophic collapse.

A list of structurally critical members and the critical areas for defects in these members is provided in Appendix 2.

## 10 Transoms

The defect limits for transom condition shall be applied using the following definitions

Failed / missing transoms	Are those that are broken, missing or do not give <b>vertical</b> support to the rails.
Effective transoms	Transom/fastener system where the required fastenings are in place and which provides <b>vertical</b> support and <b>lateral</b> restraint. Restraint must allow no lateral movement of the fastenings relative to the transom. The transom must provide gauge restraint and must be one piece that will not separate along its length or transversely. Transoms must have a flat rail plate seat within 2mm. Transoms may not have more than 20% loss from any part. A transom that can be re-drilled will become effective again. It must have sufficient material between the rail fastenings (in the "four foot") to distribute the load adequately.
Ineffective transoms	Transom that is not effective. Transoms with rot or holes through which "daylight" can be seen are not satisfactory.

For the purposes of assessment ineffective transoms include those that are missing or failed.

## Appendix 1 Defect category limits

Member	Defect Type	Defect Size	Defect Category	Mandatory Repair Priority	
<b>A. Underbridges – Steel and Wrought Iron</b>					
For steel, wrought iron and broad flange beam underbridges items in the table are defined as follows: <b>Main structural members</b> are main girders, cross girders, stringers, truss chords, diagonals and verticals, columns, trestle legs and headstocks. <b>Secondary structural members</b> are bracing, bearing/bed plates, gusset plates, bearing and web stiffeners, tie bars etc. An <b>element</b> of a member is typically a flange or web and may consist of multiple plates and/or angles. For piers, abutments, wingwalls and reinforcement see Underbridges – Concrete					
Main member (excluding BFBs)	New crack or extension of previously assessed crack	> 80mm long (total if old & new)	A		
		50mm - 80mm long (total if old & new)	B - 20kph speed Observe under load		
		10mm – 49mm long (total if old & new)	B		
	New crack	0mm-9mm long	C		
	Missing	Any	A		
Main member	Crack at bearing zone	> 300mm	C		
		≤300mm	D		
Main member	Corrosion loss	Perforation to any element	C		
		> 60% section loss	C		
		30-60% section loss	D		
		< 30% section loss	E		
Secondary member	Crack	Any	D		
	Missing	Any	B		
	Corrosion loss	Perforations to any element	D		
Main Member Fastenings (at connections)	Bolts / Rivets missing	> 60%	A		
		Loose	> 60%	B	
		Loose / Missing	40% to 60%	B	
			20% to 39%	C	
Main Rivets	Corroded away in any 600mm length of girder	> 50% of rivet heads	C		
		≤ 50% of rivet heads	D	Ry2	
Secondary Fastenings	Missing	> 75%	B		
		Loose	> 75%	C	
		Loose / Missing	50% to 75%	D	
			25% to 49%	E	Ry2
Segmental Bearings	Locked over		D. Reset but only after structural /geotechnical investigation into abutment stability		
Bed or Bearing Plate HD Bolts	Missing / Broken	> 50%	D		
		≤ 50%	E	Ry2	



Member	Defect Type	Defect Size	Defect Category	Mandatory Repair Priority
Bed Plate	Broken		D	
Bearing Pads	Broken / Missing mortar	> 25%	D	
		≤ 25%	E	
Painting – any member	Flaking paint	Any	D	
<b>Impact Damage</b>				
Track	Out of alignment (bridge has moved)	> 50mm	A	
		30mm – 50mm	B	
		≤ 30mm	D	
Main member	Major structural damage	Structure likely to be unable to carry load	A	
Girder Flange	Flange outstand deformed vertically	> 60% of outstand width	B	
		30-60% of outstand width	C	
		20-29% of outstand width	D	
		< 20% of flange outstand width	E	
	Flange deformed horizontally within bracing bay	> 60mm	B	
		30mm – 60mm	C	
		20-29mm	D	
		< 20mm	E	
Notched	> 30mm	B		
	≤ 30mm	C		
Trestle	Column deformed in any direction	> 100mm	A	
		50-100mm	B	
		25mm-49mm	D	
		< 25mm	E	
Main Rivets	Sheared off in any 600mm length of girder	> 50% of rivets	D	
		≤ 50% of rivets	E	
Any Joint Fastenings	Rendered ineffective	> 50%	B	
		≤ 50%	D	
<b>B. Underbridges – Broad Flange Beams</b>				
All the above limits for steel and wrought iron underbridges apply to B.F.B. underbridges except for the “Main Girder/Truss”, “New Crack” items which are to be replaced with the following.				
<b>Unplated B.F.B. spans</b>				
BFB Flange	Crack	> 25mm	A	
		10-25mm	B - observe under load. Stop road traffic during passage of each train	
		5-9mm	B	
		< 5mm	C	

Member	Defect Type	Defect Size	Defect Category	Mandatory Repair Priority				
<b>Plated B.F.B. spans</b>								
<b>Both</b> BFB Flange and Flange plate	Crack	> 25mm	A					
		10-25mm	B - observe under load. Stop road traffic during passage of each train					
		5-9mm	B					
		< 5mm	C					
<b>Either</b> BFB Flange or Flange plate	Crack	> 50mm	A					
		20-50mm	B - observe under load. Stop road traffic during passage of each train					
		10-19mm	B					
		< 10mm	C					
<b>C. Underbridges – Timber</b>								
The following maintenance limits are based on nominal 300mm x 300mm timber section								
Girder/Corbel	Pipe / Trough in any girder or corbel	> 250mm	A					
		226-250mm	B					
		200-225mm	C					
		151-199mm	D					
		50-150mm	E					
	Crushing		B					
Solid Headstock	Pipe / Trough	> 250mm	A					
		226-250mm	B					
		200-225mm	C					
		151-199mm	D					
		50-150mm	E					
	Crushing	Any	B					
Girder	Mid span deflection	Exceeds values tabulated below				B		
		Span (m)	4.27	4.57	7.32		7.92	
		Deflection (mm)	8	9	20		22	
Girder/Corbel small section 250x150mm	Rotted out				B			
Waling Headstock	Rotted out				B			
Waling Sill	Rotted out				C			
Body Bolts	Loose	> 25%			D			
		≤ 25%			E			
Corbel bolts	Loose	> 25%			D			
		≤ 25%			E			
Trestle Bolts	Loose	> 25%			D			
		≤ 25%			E			

Member	Defect Type	Defect Size	Defect Category	Mandatory Repair Priority	
Piles	Section loss in more than 50% of piles in any trestle or abutment	> 75%	A		
	Section loss in more than 25% of piles in any trestle or abutment	> 75%	B		
	Section loss in any pile	> 75%	C		
		50-75%	D		
		40-49%	E		
Pumping	Any	D			
Decking	Split or rotted out	> 20%	D		
Abutment and wingwall sheeting	Broken, decayed, missing or displaced	Any	D		
Any Timber Section	Termite infestation	Any evidence of damage	C		
<b>D. Underbridges – Timber Transoms</b>					
<b>Track class</b>		<b>1, 2, 3</b>	<b>5</b>		
Transoms	Ineffective	3 Adjacent	4 Adjacent	B	
		2 Adjacent	3 Adjacent	C	
		2 in 3	2 Adjacent	D	
		One isolated		E	
Transom Bolts	Missing	3 Adjacent transoms	4 Adjacent transoms	B	
		2 Adjacent transoms	3 Adjacent transoms	C	
		One transom (2 bolts) isolated	2 Adjacent transoms	D	
	Loose	Any		E	Ry2
<b>E. Underbridges – Concrete</b>					
Main-P.S.C or R.C	Differential deflection between units under live load	Visible	C		
Main-P.S.C	Crack	Other than shrinkage (surface) crack > 0.3mm	B		
Main-R.C	Crack	> 3mm wide	C		
		1-3mm wide	E	Ry2	
Main Reinforcing. Bar	Section loss in one bar	> 30%	D - Undertake diagnostic testing		
Stirrup Reinforcing.	Section loss in one bar	> 60%	D - Undertake diagnostic testing		
Prestressing Ducts/Tendons	Exposed	Any	C		
Piers/Abutments	Crack	> 5mm wide & 1 metre long especially under bearings	C		
		3-10mm wide	E		

Member	Defect Type	Defect Size	Defect Category	Mandatory Repair Priority
Wingwall	Crack	> 5mm wide & 2 metres long	C	
		3-10mm wide	E	
	Lateral dislocation	> 20mm	D	
Deck	Spalling	> 1 square metre with exposed reinforcing	D - Undertake diagnostic testing	
		300mm x 300mm & no reinforcing exposed	E - Undertake diagnostic testing	Ry2
Deck – joint between slabs	Fouling with ballast/debris	Any	D	
Bearings		Any degradation	D	
<b>Impact Damage</b>				
Main	Deformation	Any	A	
Main-P.S.C or R.C.	Crack	Other than shrinkage (surface) crack more than 0.3mm	A	
<b>F. Underbridges – Masonry and Concrete Arch</b>				
For piers, abutments, wingwalls and reinforcement see Underbridges – concrete				
Arch Ring	Brickwork dislocation	> 50% in any square metre missing or unbonded	B	
		20-50% in any square metre missing or unbonded	D	
	Longitudinal cracking (along arch barrel)	> 3mm wide, through & across full arch width. Visible differential movement under live load	B	
		2-3mm & not through & across	D	
		< 2mm & not through & across	E	
	Circumferential cracking (along arch profile)	> 6mm wide & > 2m long along arch	C	
		3-6mm wide, or > 6mm wide and < 2m long along arch	D	
	Distortion of profile	> 50mm – detectable by undulations in top line of spandrel walls / parapets or track	D	
		20-50mm	E	
	Other than Arch	Brickwork dislocation	> 50% in any square metre missing or unbonded	D
20-50% in any square metre missing or unbonded			E	
Spandrel Wall	Displacement	Longitudinal > 30mm, or > 20mm Longitudinal + 20mm tilt	D	
		15-30mm	E	
Culvert floor	Heaving	> 50mm	D	
		25-50mm	E	

Member	Defect Type	Defect Size	Defect Category	Mandatory Repair Priority
Any other	Brickwork dislocation	Nil	D	
Brickwork mortar	Missing or loose	More than 30% in any square metre missing or loose	D	
		10-30% in any square metre missing or loose	E	
<b>G. Culverts and Pipes</b>				
For reinforcement see Underbridges – concrete				
Culvert, corrugated metal pipe or timber box drain	Collapse	Subsidence of formation/ballast	A	
		No subsidence of formation/ballast	C	
	Blocked	75 - 100%	C	
		50 - 74%	D	
		20 - 49%	E	Ry2
Culvert	Cracked barrel	> 50mm	B	
		10-50mm	D	
		< 10mm	E	
Corrugated Metal Pipe	Joint Broken	-	D	
	Out of round / distortion	> 50mm	D	
Headwall / Wingwall	Cracked	> 50mm wide	B	
		10-50mm wide	D	
		< 10mm	E	
Apron	Scouring under	> 2m	C	
		Any	D	
Floor	Heaving	> 50mm	D	
		25 - 49mm	E	
Adjacent Waterways	Blocked - Geotechnical risk site	> 25%	C	
	Blocked	> 25%	D	
<b>H. Overbridges – Timber</b>				
The following maintenance limits are based on nominal 300mm x 300mm timber section The restrictions are to be applied to the road across the overbridge				
Girder/Corbel	Pipe / Trough in any girder or corbel	> 250mm	A – Close bridge	
		226-250mm	B	
		200-225mm	C	
		151-199mm	D	
		50-150mm	E	
	Crushing		B	

Member	Defect Type	Defect Size	Defect Category	Mandatory Repair Priority			
Solid Headstock	Pipe / Trough	> 250mm	A – Close bridge				
		226-250mm	B				
		200-225mm	C				
		151-199mm	D				
	50-150mm	E					
	Crushing	Any	B				
Girder	Mid span deflection	Exceeds values tabulated below				B	
		Span (m)	4.27	4.57	7.32		7.92
		Deflection (mm)	8	9	20		22
Girder/Corbel small section 250x150mm	Rotted out		B				
Waling Headstock	Rotted out		B				
Waling Sill	Rotted out		C				
Body Bolts	Loose	> 25%	D				
		≤ 25%	E				
Corbel bolts	Loose	> 25%	D				
		≤ 25%	E				
Trestle Bolts	Loose	> 25%	D				
		≤ 25%	E				
Piles	Section loss in > 50% of piles in any trestle or abutment	> 75%	A - Stop trains				
	Section loss in > 25% of piles in any trestle or abutment	> 75%	B				
	Section loss in any pile	> 75%	C				
		50-75%	D				
		40-49%	E				
Decking planks (transverse)	Broken or missing, bolts protruding	two or more adjacent planks have collapsed	B				
		isolated planks have collapsed	C				
Decking planks (longitudinal)	Rotted out or loose, bolts protruding	two or more adjacent planks have collapsed	B				
		isolated planks have collapsed	C				
Wearing surface	Holes or lifting	Any	C				
<b>I. Footbridges and Overbridges</b>							
In addition to the following, Underbridge defect limits also apply where applicable							
Brick parapets	Horizontal crack	> 3mm wide & > ½ of parapet width & > 2m long	D				
Brick parapets	Vertical crack	Any crack full height and full width of parapet	D				

Member	Defect Type	Defect Size	Defect Category	Mandatory Repair Priority
<b>Pedestrian Safety Aspects</b>				
The bridge and stepway maintenance triggers described are of a structural nature and intentionally do not cover defects in walking surface finishes, ie tiles, etc. and associated anti-slip requirements				
Pedestrian Barriers	Missing / Broken	Any	B - Seal off area	
	Missing / Displaced chain wire infill	Any	B - Seal off area	
	Missing vertical balusters	Any	B - Seal off area	
	Missing displaced metal sheet	Any	B - Seal off area	
	Loose	Any	D	
	Missing bolts	Any	D	
Traffic Barriers	Missing / Broken / Loose	Any	C	
Deck	Walkway planks	Broken, decayed, missing or displaced	B - Seal off area	
	Cracks in AC/FC sheets	Any	B - Seal off area	
Deck-Nails, Screws	Protrusion above deck	> 10mm	C	
		≤10mm	D	
Safety Screens	Missing / Broken	Any	C	
Safety Screen Fixings	Defective	> 50%	C	
		25-50%	D	
Timber Railing, Posts	Section loss	> 25%	D	
Protection Screens	Missing / Broken / Loose	Any	D	
	Missing bolts	Any	D	
<b>Stepways (also includes balustrade and handrail references above)</b>				
R.C. Stepway Tread	Broken front edges	> 150mm long x 35mm deep	C	
		> 50mm long x 15mm deep	D	
	Cracked	> 2 mm wide	D	
R.C. Stepway Landing	Cracked	> 2 mm wide	D	
		≤2 mm wide	E	
Stepway Reinforcing	Protruding at toe	Any	C	
Stepway Tread	Rocking between heel and toe	> 5mm	C	
		2-5mm	D	
	Slope heel to toe	> 15mm	D	
		5-15mm	E	
<b>J.Underbridge walkways and refuges</b>				
Walkway & Refuge Handrails	Missing / Broken	Any	B - Seal off area	
Walkway & Refuge Planks	Broken, decayed, displaced or missing	Any	B - Seal off area	
Walkway fastenings	Loose or missing	Any	D	

Member	Defect Type	Defect Size	Defect Category	Mandatory Repair Priority
<b>K. Underbridge guardrails</b>				
Guardrail	Missing	-	D	
	Undersize	-	D	
Vee section	Missing / End not closed	-	D	
Fastenings	Missing / Loose	-	D	
<b>L. Underbridge road/pedestrian safety aspects</b>				
Clearance signs	Missing	-	D	
	Not legible	-	D	
Ballast	Falling	-	D	
<b>M. Underbridge Ballast Logs/Walls</b>				
Ballast Log	Missing / Rotted out	-	D	
Ballast Wall	Decayed, displaced or missing	-	D	
<b>N. Tunnels</b>				
Roof/Wall	Brickwork dislocation	> 30% in any square metre missing or unbonded	C	
		10-30% in any square metre missing or unbonded	E	
	Longitudinal cracking (along tunnel)	> 5mm wide & more than 5m long	B	
		2-5mm & more than 5m long	C	
		≤ 2mm & more than 5m long	D	
	Circumferential cracking (along tunnel profile)	>5mm wide & > 2m long along unnel profile	D	
		>5mm wide ≤ 2m long along tunnel profile	E	
	Spalling	Through the lining or of whole bricks	D	
	Seepage	Causing corrosion of track fastenings	D	Ry1
		Any	E	
Portal	Crack	>50mm wide	B	
		10-50mm wide	D	
		≤10mm	E	
<b>O. Retaining Walls and Platform Walls</b>				
Retaining wall	Crack	>10mm wide & > 2 metres long	C	
		>10mm wide & ≤ 2 metres long	D	
		5-10mm wide	E	
	Lateral dislocation	>20mm	C	
		10-20mm	E	
Platform wall	Crack	>50mm wide	C	
		10-50mm wide	D	
		< 10mm	E	



Member	Defect Type	Defect Size	Defect Category	Mandatory Repair Priority
Platform coping	Separation from platform surface and/or wall	Visible	D - Check clearances for possible infringement	
	Broken edging	Any	D	
<b>P. Gabion Walls</b>				
Gabion baskets - bridges	Damaged	Loss of tension/Rocks spilling out	D	
	Lateral dislocation	> 100mm	D	

## Appendix 2 Structurally critical members

A. Steel and wrought iron underbridges		
Span Type	Structurally Critical Member	Details of Critical Areas
Plate web deck, RSJ and BFB	Main girders	Bottom flange: middle third of span
		Top flange: over intermediate piers and buckling at mid spans
		Web splices: middle half of span
		Web: at support
Plate web through	Main girders	Bottom flange: middle third of span
		Top flange: over intermediate piers and buckling at mid spans
		Web splices: middle half of span
		Web: at support
	Cross girders	Bottom flange: middle half of span and end connections
		Web: at support
	Stringers	Bottom flange: middle half of span and end connections
		Web: at support
Lattice girders	Top chord	Over intermediate piers and buckling at mid spans (arches)
	Bottom chord	Middle third
	Arches/ portal frames	Mid-span arches at end connections
	Stringers (2 <sup>nd</sup> generation)	Bottom flanges and splices: middle third
	Cross girders	Connections to bottom chord. Middle third of bottom flange
	Diagonal lattice bars	Whole member including chord connections, especially in vicinity of supports
Trusses (Pratt)	Top chord	Buckling at mid-span
	Bottom chord	Middle half of span
	Portal frames	Mid-span frames at end connections
	Cross girders	Middle half of span and connections to bottom chords
	Stringers	Middle half of span and end connections
	First web verticals	Whole member, including connections
	Internal web diagonals	Whole member towards abutments
B. Timber bridges		
All spans	Girders	Middle third (bending) and over corbels (shear)
	Corbels	Over headstocks (shear)
	Headstocks	Nil
	Piles	At ground level , and 500mm above and below ground level
	Transverse decking	Middle third (bending)
C. Concrete bridges		
All spans	Pre-Stressed Concrete Girders	Middle third of span
		Over supports (shear)
	Reinforced Concrete Girders	Middle third of span
		Over supports (shear)