

Technical Direction

Bridge

BTD 2007/08 Rev 2 | RMS 18.1106 – 20 November 2018

Design of Replacement Traffic Barriers on Existing Bridges

Summary:	Audience:
This bridge technical direction sets the requirements and provides tools for the design of replacement traffic barriers for existing bridges.	<ul style="list-style-type: none"> • Bridge designers and drafters • Project managers • Asset managers • Industry partners

Background

The requirements for the design of replacement traffic barriers on existing bridges have been changed by the publication of the second edition of AS(AS/NZS) 5100 Bridge design in March 2017.

BTD 2007/08_Rev1 specified these requirements prior to that date in accordance with the first edition of AS 5100 published in May 2004.

The current requirements for the design of replacement traffic barriers for existing bridges can be found in Part 1 *Scope and general principles*, Part 2 *Design loadings* and Part 8 *Rehabilitation and strengthening of existing bridges* of AS(AS/NZS) 5100.

Approvals:

Owner:	Wije Ariyaratne Director Bridges and Structures	Review Date:	15 November 2023
Authorised by:	Chris Harrison Director of Engineering	Effective Date:	27 September 2007 (1 st issue) 18 November 2009 (Rev 1) 15 November 2018 (Rev 2)

Information and bridge technical direction

This bridge technical direction must be applied in conjunction with the relevant clauses of AS(AS/NZS) 5100.

The process for designing replacement bridge traffic barriers must generally be in accordance with the flow chart in Appendix C of AS 5100.8.

To determine the required barrier performance level, the designer must undertake a site specific risk assessment for the bridge in accordance with Clause 14.5.1 of AS 5100.1. A suitable form for undertaking the risk assessment is provided in Appendix A to this technical direction. The bridge approaches must also be considered in the risk assessment. The bridge traffic barrier design solution should be consistent along the road length being considered.

Appendix A of this technical direction must be used when collecting information about the existing bridge for determining the barrier performance level. The forms must be completed by the asset manager or delegate.

Appendix C of this technical direction must be used as a guide when recording other important information during the inspection of the traffic barrier on the existing bridge.

Appendix D of this technical direction must be used to identify typical hazards that may be observed during the barrier inspection to provide additional information for determining the most suitable design solution.

If the bridge cannot be economically strengthened to install a traffic barrier to the barrier performance level specified in AS(AS/NZS) 5100 or this technical direction then the highest barrier performance level achievable within the economic constraints applicable to the site can be adopted. If none of the barrier performance levels can be provided, then, as a minimum, the hazards identified in Appendix D or as determined otherwise must be eliminated.

The concurrence of the Asset Manager and Director Bridges and Structures or their delegates must be obtained on the barrier performance level proposed.

Where the proposed barrier performance level is less than that required from the risk assessment, then alternative amelioration strategies must be considered including reduced speed limits or advance warning signs.

The resulting bridge traffic barrier design solution must take into account any adverse impact on vulnerable road users such as cyclists or pedestrians. Bridge traffic barrier designs must not introduce or allow the continued existence of the barrier hazards identified in Annexure D.

For the rehabilitation of existing bridges in NSW or for the repair of existing barriers, an additional two barrier performance levels (basic and intermediate) are provided in Table 1, Table 2 and Table 3 in addition to those specified in Clause 14.5.1 of AS 5100.1. These tables have been adapted from Table 14.4 of AS 5100.1 and Tables 12.2.2, 12.2.3 and Appendix A of AS 5100.2.

A bridge traffic barrier is considered achieving a performance level if it fully meets the geometric and strength requirements of that performance level. The provision relevant to partial achievement of the performance level strength in Clause 9.5 of AS 5100.8 must not apply.

The information gathering, risk assessment, design, decision making and approval as well as works-as-executed drawings must be recorded using the applicable bridge number on the relevant bridge file and Objective and be cross referenced in the bridge information system (BIS).

Table 1: Crash test vehicles and criteria for different performance level barriers

Barrier performance level	Vehicles	Test speed	Impact angle	MASH 2009 ¹
		km/h	Degrees	Test level
No barrier	Refer to Clause 14.5.2 of AS 5100.1			
Basic	1.1 t small car	50	25	TL1
	2.27 t utility ²	50	25	
Low	Refer to Clause 14.5.3 and Table 14.4 of AS 5100.1			
Intermediate ³	1.1 t small car	100	25	NA
	2.27 t utility ²	85	25	
Regular	Refer to Clause 14.5.4 and Table 14.4 of AS 5100.1			
Medium	Refer to Clause 14.5.5 and Table 14.4 of AS 5100.1			
Special (I)	1.1 t small car	100	25	TL6
	2.27 t utility ²	100	25	
	36 t articulated tanker ¹	100 ³	15	
Special (II)	1.1 t small car	100	25	NA ⁴
	2.27 t utility ²	100	25	
	44 t articulated van ²	100	15	
Special (III)	To be specified by Roads and Maritime regional bridge maintenance planner ⁵			

Notes to Table 1:

1. indicates *Manual for Assessing Safety Hardware (2009)*
2. indicates controlling strength test vehicle
3. Performance level determined by Roads and Maritime, there is no equivalent MASH test level.
4. This magnitude is larger than that in MASH for TL6
5. Alternative criteria may be determined by Roads and Maritime for other special performance level barriers, including combined barriers for traffic with cyclists, livestock, and the like, or 'one-off' extreme risk situations

Table 2: Traffic barrier design loads and contact lengths

Barrier Performance Level	Ultimate transverse outward load (F_T)	Ultimate longitudinal or transverse inward load (F_L)	Vehicle contact length for transverse load (L_T) and longitudinal load (L_L)	Ultimate vertical downward load (F_V)	Vehicle contact length for vertical loads (L_V)
	kN	kN	m	kN	m
Basic	90	40	1.1	20	5.5
Low	Refer to Clause 12.2.2 of AS 5100.2				
Intermediate	225	75	1.1	60	5.5
Regular	Refer to Clause 12.2.2 of AS 5100.2				
Medium	Refer to Clause 12.2.2 of AS 5100.2				
TL6 (36 t articulated tanker)	Refer to Clause A2 of AS 5100.2				
> TL6 (44 t articulated van)	Refer to Clause A2 of AS 5100.2				

Table 3: Minimum effective height of traffic barrier

Barrier Performance Level	Minimum Effective Height (H_e)	Minimum Overall Height
	mm	mm
Basic	500	700
Low	Refer to Clause 12.2.3 of AS 5100.2	700
Intermediate	700	700
Regular	Refer to Clause 12.2.3 of AS 5100.2	N/A ¹
Medium	Refer to Clause 12.2.3 of AS 5100.2	N/A ¹
Special (I) and (II)	Refer to Clause A3 of AS 5100.2	To be specified ²
Special (III) – Other	To be specified by Roads and Maritime regional bridge maintenance planner	

Notes to Table 3:

1. No specific requirement for overall barrier height.
2. To be specified by Roads and Maritime regional bridge maintenance planner.

Appendix A: Site specific risk assessment form for determining required performance level of replacement traffic barriers

Bridge Site :

Conditions for NO BARRIERS (must be "yes" to all questions)

- 1 Bridge < 1.5 m above the ground.
- 2 Traffic volumes < 150 vehicles per day.
- 3 Radius of curvature such that in road approaches sight distance > stopping distance.
- 4 Width between kerbs ≥ 6.5 m for 2 lane bridge and ≥ 4.2 m for one lane bridge.
- 5 Edge of bridge ≥ 1.0 m from edge of traffic lane.
- 6 No anticipated pedestrian traffic or/and cyclist path.
- 7 Any water beneath the bridge normally < 1.2 m deep.
- 8 Barrier would obstruct passage of debris or may be damaged by regular heavy debris.

(Y / N)

Barrier required / Barrier not required

Conditions for BASIC PERFORMANCE LEVEL barriers

If some of the questions 1 to 3 and 5 to 8 above cannot be answered "yes" but the conditions are more favourable than those requiring LOW PERFORMANCE LEVEL barriers, consideration may be given to adopting BASIC PERFORMANCE LEVEL barriers.

Applicable / Not Applicable

Conditions for LOW PERFORMANCE LEVEL barriers (must be "yes" to all questions)

- 1 Bridge on road with low volume of traffic (< 500 vehicles/day).
- 2 Bridge on low to medium height above ground or water (< 4 m).
- 3 Bridge with an essentially straight alignment (radius > 1500 m).
- 4 Width between barriers ≥ 6.5 m for 2 lane bridge and ≥ 4.2 m for one lane bridge.

Applicable / Not Applicable

Conditions for INTERMEDIATE PERFORMANCE LEVEL barriers

If the site conditions listed in 1 to 3 above are exceeded and cannot be answered "yes" consideration may be given to adopting INTERMEDIATE PERFORMANCE LEVEL barriers.

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Applicable / Not Applicable

REGULAR PERFORMANCE LEVEL barriers

For new bridges, as a minimum, regular performance level barriers shall be provided for the effective containment of general traffic on all roads unless AS 5100.1 Cl 14.5 permits a lower performance level or requires a higher performance level.

(Y / N or N/A)

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Applicable / Not Applicable

Conditions for MEDIUM PERFORMANCE LEVEL barriers

Medium performance level barriers shall be provided for medium to high risk situations for effective containment of medium to high mass vehicles and buses on all roads.

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Applicable / Not Applicable

For medium to high volume of heavy vehicles, a risk assessment shall be carried out for:

- 1 Bridges over major roadways.
- 2 Bridges over high frequency passenger railway lines or goods lines carrying noxious, flammable or large volumes of freight, or critical railway infrastructure.
- 3 Bridges over high occupancy land use.

Required / Not Required

For medium to high volume of buses, a risk assessment shall be carried out for :

- 1 Bridges > 10 m high.
- 2 Bridges over deep water (> 3.0 m deep under normal flow conditions).
- 3 Bridges over major roadways.
- 4 Bridges over high frequency passenger railway lines or goods lines carrying noxious, flammable or large volumes of freight, or critical railway infrastructure.
- 5 Bridges over high occupancy land use.

Required / Not Required

Conditions for SPECIAL PERFORMANCE LEVEL of Barriers

Special performance level barriers shall be provided for :

- 1 Effective containment of heavy, high centre of gravity vehicles in high risk situations* on high speed freeways, major highways and urban arterial roads with high volume of mixed heavy vehicles.
- 2 Site-specific, unusual conditions at critical locations.
- 3 Locations where it is essential that a penetration of, or vaulting by, vehicles identified by the RMS* under impact conditions needs to be prevented.

Applicable / Not Applicable

Site-specific justification shall be based on risk assessment, with particular emphasis on third party risk for situations including, but not limited to, high risk, critical adjacent facilities such as power stations, gas tanks, oil refineries and communication facilities.

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Required / Not Required

Based on the above site-specific risk assessment, the required performance level of the barrier to be provided on the existing bridge is:

* Vehicles that require containment need to be identified by RMS. A high risk situation is one where penetration of the identified vehicles represents an unacceptable risk to the occupants or to other persons or property.

Appendix B: Data collection form

Sheet B1 – General design information

Bridge Number :
 Road Number : Date :
 LGA : Name :
 Bridge Name :
 Bridge Over :
 Location :
 Overall Length :
 Skew Angle :
 Year Built :
 General File Number :
 Plan Regn. No. of Drawings :



Span No.	Span Description (e.g. RC slab, steel truss, composite steel girder/RC deck, timber truss, PSC planks, etc)	Span Length (m)	LHS				Median Width (m)	RHS				Total Width (m)
			Footway or Kerb Width (m)	Shoulder Width (m)	Number of Lanes	Lane Width (m)		Number of Lanes	Lane Width (m)	Shoulder Width (m)	Footway or Kerb Width (m)	
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
Overall Length												

Sheet B2 – Bridge data

Bridge Name :
 Bridge Number:

Date :
 Name :

Bridge over :

Water	<input type="text"/>	(Y / N)
Dry ground, creek	<input type="text"/>	(Y / N)
Road	<input type="text"/>	(Y / N)
Railway (train frequency)	<input type="text"/>	(Y / N) (<input type="text"/>)
High occupancy land use	<input type="text"/>	(Y / N or high, med, low)
Other	<input type="text"/>	

Bridge deck height above ground (Max)	<input type="text"/>	m
Bridge deck height above average water level (Max)	<input type="text"/>	m
Depth of water at average water level (Max)	<input type="text"/>	m
Fast flowing water	<input type="text"/>	(Y / N / Tidal)
Water flow speed	<input type="text"/>	m/s
Bridge subject to flooding	<input type="text"/>	(Y / N)

Road Alignment:

Straight	<input type="text"/>	(Y / N)
Horizontal curve radius	<input type="text"/>	m
Vertical curve	<input type="text"/>	(Y / N)
Vertical curve radius	<input type="text"/>	m

Stopping sight distance m

TRAFFIC DATA

Signposted road speed limit	<input type="text"/>	km/h
Traffic volume (AADT)	<input type="text"/>	
Percentage commercial vehicles	<input type="text"/>	%
Type of commercial vehicles:		
Heavy	<input type="text"/>	(Y / N)
High centre of gravity	<input type="text"/>	(Y / N)
Busses (AADT)	<input type="text"/>	(Y / N) (<input type="text"/>)
Bridge used by pedestrians	<input type="text"/>	(Y / N)
Bridge used by cyclists	<input type="text"/>	(Y / N) (<input type="text"/>)

TYPE OF CARRIAGEWAY

Two way undivided	<input type="text"/>	(Y / N)
Two way divided	<input type="text"/>	(Y / N)
One way carriageway	<input type="text"/>	(Y / N, northbound, southbound)

Sheet B3 – Hazards

Bridge Name : Date :
 Bridge Number: Name :

Reasons for considering
 Bridge for a traffic barrier upgrade

Accident prone bridge site (Y / N)
 Details

Unprotected pedestrian or/and cyclist path on bridge (Y / N)
 Pedestrian or/and cyclist protection required (Y / N)

Existing Traffic Barrier Details

Perceived inadequate strength to contain:

Small cars	<input type="text"/>	(Y / N)
Utilities	<input type="text"/>	(Y / N)
Rigid trucks	<input type="text"/>	(Y / N)
Articulated vans	<input type="text"/>	(Y / N)
Inadequate rigidity (too flexible)	<input type="text"/>	(Y / N)
Inadequate ductility (too brittle)	<input type="text"/>	(Y / N)
Inadequate height	<input type="text"/>	(Y / N)
Inadequate continuity (gaps)	<input type="text"/>	(Y / N)

Current Bridge Traffic Barrier Hazards

Barrier elements may spear vehicle	<input type="text"/>	(Y / N)
Barrier too rigid without protection	<input type="text"/>	(Y / N)
Protruding kerbs (refer to Appendix D)	<input type="text"/>	(Y / N)
Other hazards (refer to Appendix D)	<input type="text"/>	
Details	<input type="text"/>	

Road Barriers on Bridge Approaches

Approach barrier present	<input type="text"/>	(Y / N)
Inadequate rigidity (too flexible)	<input type="text"/>	(Y / N)
Inadequate connection	<input type="text"/>	(Y / N)
Inadequate anchorage	<input type="text"/>	(Y / N)
Inadequate transition to bridge barrier	<input type="text"/>	(Y / N)
Inadequate clear zone on approaches	<input type="text"/>	(Y / N)
High embankment on approaches	<input type="text"/>	(Y / N)
Other hazards (refer to Appendix D)	<input type="text"/>	
Details	<input type="text"/>	

Appendix C: Traffic barrier inspection report

Bridge Over : Name :
 Location : Date :
 Road :
 Bridge Number :
 Description :

Photo : **Attach photos**

		DIRECTION		DIRECTION	
↑	From:			From:	↓
	To:			To:	
	Observations	Recommendations	Observations	Recommendations	
DEPARTURE BARRIER					APPROACH BARRIER
	Photo :				
CONNECTION					CONNECTION
	Photo :				
END POST					END POST
	Photo :				
CONNECTION					CONNECTION
	Photo :				
BRIDGE BARRIER					BRIDGE BARRIER
	Photo :				
BARRIER SPLICE CONNECTION					BARRIER SPLICE CONNECTION
	Photo :				
BRIDGE BARRIER					BRIDGE BARRIER
	Photo :				
CONNECTION					CONNECTION
	Photo :				
END POST					END POST
	Photo :				
CONNECTION					CONNECTION
	Photo :				
APPROACH BARRIER					DEPARTURE BARRIER
	Photo :				

Appendix D: Existing bridge traffic barrier hazards

Traffic barrier hazards:

- Unprotected rigid barrier (e.g. barrier ending on an end post that does not have any guardrail attached on the approach side)
- Elements that may spear vehicle
- Discontinuities in horizontal rails
- Inadequate barrier height
- Barrier too brittle/fragile (e.g. lightly reinforced concrete rails, timber barriers, etc)
- Barrier too flexible (e.g. chain mesh)
- Inadequate guardrail connection
- Inadequate guardrail anchorage
- Approach barrier too flexible
- Insufficient stiffness transition
- High embankments
- Lack of containment.
- Protruding kerbs (e.g. kerbs that are placed in front of a barrier from the traffic side where they could impact on the performance of the barriers - refer to photos below).





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