Specification

Civil – Road/Rail Interface Barriers

MD-20-40
(Previously CIVIL-SR-007)

QUEENSLAND RAIL OFFICIAL

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Policy: Safety Policy

QueenslandRail

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1 Purpose

The purpose of this specification is to define the requirements for road and road bridge safety barrier systems adjacent to the Queensland Rail Corridor. The requirements of this Specification shall be met by parties undertaking the design and works of roads where it is in proximity to the rail corridor.

An intrusion into the railway corridor by an errant vehicle, loss of cargo onto the rail track or debris resulting from an event may cause a major incident or impacts to both railway and road operations. A major incident may result in:

- significant loss of life to rail passengers and the occupant(s) of the road vehicle(s);
- damage to vehicle(s) and train(s);
- derailed train being hit by a train on adjacent tracks;
- track blockage;
- Significant economic impact;
- delays due to:
  - the time taken for debris removal
  - damage to infrastructure (i.e. signalling equipment).

The current standards for road and bridge barriers assume that the main risk of an errant vehicle is to the occupants of the vehicle. While the Austroads Guide to Road Design (2010) Part 6 and Queensland Transport and Main Roads "Road Planning and Design Manual" Volume 3 treat the railway as a hazard, they do not address the requirements of the Rail Safety National Law (Queensland).

This Specification sets out requirements for barrier selection and design using a risk assessment methodology. It has been further supplemented with a systematic process for barrier selection.

1.1 Business or technical need?

This Specification addresses the requirements of Rail Safety National Law (Queensland).

The consequence of a vehicle entering the rail corridor is a critical parameter in developing this Specification. Road traffic barriers are designed on an 85 percent probability of exceedance. However, railways are legally required to operate safely So Far As Is Reasonably Practicable (SFAIRP). This difference in design philosophy has been addressed in this Specification which may result in a barrier with a higher level of protection.

1.2 Scope

This specification shall be applied by the Proponent for the design and construction of:

- A new track adjacent to an existing road;
- A new or upgraded road adjacent to an existing railway.

This specification should be applied where there is a change in road operational conditions (e.g. speed or traffic volumes). Refer to Section 2.6.3.

1.3 Exclusions

Exclusions to this document include:

- Level crossings (refer to Civil - Level Crossing Safety Standard MD-10-115);
- Barriers adjacent to construction sites.

2 Requirements of this Specification

2.1 Barrier Selection and Design Process

Barrier selection and design shall be undertaken based on the Rail Status of the track adjacent to the road. The process is outlined in Figure 1. Rail Status is defined in Section 2.2.

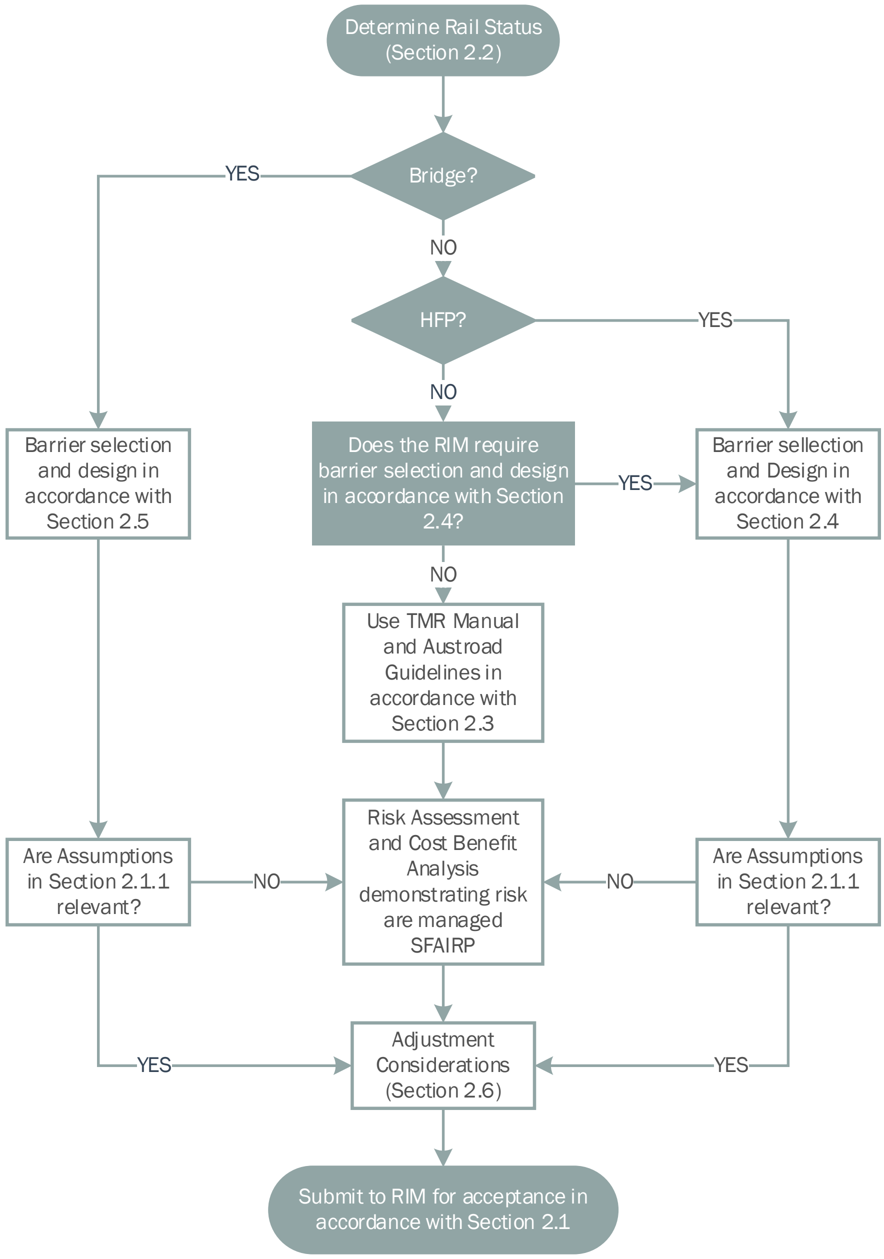
Barrier selection and design shall be in accordance with Section 2.3. Except where:

- the Rail Status is determined to be High Frequency Passenger (HFP), barrier shall be in accordance with Section 2.4;
- the road overpasses the rail, barriers shall be in accordance with Section 2.5

The Rail Infrastructure Manager or Road Authority may require barriers to be selected and designed in accordance with Section 2.4 regardless of Rail Status.

A Design Report detailing inputs and outcomes of the barrier design and selection processes, including the risk assessment, shall be submitted to Queensland Rail for acceptance by the Rail Infrastructure Manager and the Road Authority.

For situations where a barrier is being designed for change of road or rail use refer to Section 2.6.3.



* The Rail Infrastructure Manager (RIM) may require barriers to be selected and designed in accordance with Section 2.4 regardless of Rail Status.

Figure 1: Barrier Selection and Design Process

2.1.1 Assumptions

The assumptions of barrier selection and design using Sections 2.4 and 2.5 are:

- Austroads (2010) and TMR road design guidelines address the risk to the vehicle occupant;

- The barriers have been assessed to the range of vehicles from Test Level 2 to Test Level 6 in accordance with AS 3845 and AS 5100 respectively. Vehicles range from a small car to a 44 tonne articulated van;
- The train may be a commuter train or a freight or coal/mineral train.

Where a location falls outside these assumptions, an assessment shall be undertaken to determine if a different performance level barrier or height is required. Additional considerations shall be made in accordance with Section 2.6.4. For example, roads where:

- "High centre of gravity" vehicles such as double-decker cattle trucks operate (Where these vehicles form part of the traffic stream, then the height of barriers needs to be re-evaluated);
- double decker buses operate;
- there are at-grade and elevated roads with tight horizontal radius curves where the speed environment transitions between high and low speed.

Section 2.3 details supplementary requirements to the Queensland Department of Transport and Main Roads (TMR) Road Planning and Design Manual Edition 2: Volume 3 and Austroads Guide to Road Design (2010) Part 6. Refer to the respective documents for relevant assumptions.

Additional considerations may be required in accordance with Section 2.6.4.

2.2 Rail Status

The railway status shall be as given in Table 1. The Table specifies the Rail Status for most Queensland Rail Lines, Systems, and rail services. Where multiple Rail Status apply, the higher level Status shall be applied.

Where a line or passenger services is not listed in Table 1, rail traffic volumes (trains per week) may be used to determine the equivalent Rail Status. Guidance on determining rail traffic volumes is given in Appendix 3.

The Rail Infrastructure Manager may specify a Rail Status to be used for a location or project.

Rail Status	Description
HFP	High frequency passenger lines with >100 passenger trains per week. The South East Queensland Network (City Train Passenger Services) shall be considered High frequency passenger Lines.
MCP	Country Passenger Main Lines with ≥10 and <100 passenger trains per week Lines carrying the following traffic shall be considered Country Passenger Main Lines: • Tilt train lines; • The Kuranda Scenic Railway.
MCG	Goods, mineral or coal Main Lines with ≥30 and <300 non passenger trains per week: The flowing Lines and Systems shall be considered Goods/mineral/coal Main Lines: • The North Coast Line; • The West Moreton System; • The Mt Isa Line (The Great Northern Railway).
SP	Secondary passenger lines with < 10 passenger trains per week. Lines carrying the following traffic shall be considered Secondary passenger lines: • Savannahlander & Gulflander; • Inlander & Westlander; • Spirt of the Outback.
SG	Secondary goods Branch Lines with < 30 trains per week.

Table 1: Rail Status

2.3 Austroads and TMR Barrier Design (Non-HFP)

Where required by Section 2.1, barrier selection and design shall be in accordance with the Queensland Department of Transport and Main Roads (TMR) Road Planning and Design Manual Edition 2: Volume 3 Supplement to Austroads Guide to Road Design (2010) Part 6: Roadside Design, Safety and Barriers. Referred to as the TMR Road Design Manual in this document.

The TMR Design Manual is a supplement to the Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers (2010). Referred to as the Austroads Design Guide in this document.

This Section:

- details additional requirements to the TMR Road Design Manual and Austroads Design Guide that shall be met by anyone using this specification;
- has precedence over the Austroads Design Guide and TMR Road Design Manual.

This Section references refer to both the TMR Road Design Manual and the Austroads Design Guide as the documents share the same section numbering.

2.3.1 Types of Hazards (Austroads/TMR Section 4.3.2)

Addition

The Austroads Design Guide identifies transit corridors (including railways) and freight railways as a Hazard in table 4.3. In the table it states that “consideration needs to be given to not only the risk to motorists but also to users of the transit corridor or the freight railway”.

Furthermore, the Railway Corridor shall be considered a ‘continuous’ Hazard as defined in Commentary 5 of the Austroad Design Guide.

In the context of railway, a Hazard includes:

- all rail associated infrastructure, including:
  - overhead line equipment such as masts and transformers;
  - power and signalling huts and location cases;
  - signalling and communications equipment;
  - buildings;
- the area up to 3 m from the outer rail of the nearest track, referred to as the Danger Zone.

2.3.2 Generalised hazard assessment process (TMR Section 4.3.6)

Confirmation

This Section is in the TMR Road Design Manual and is an addition to the Austroads Design Guide. The process outlined in this Section shall be used when selecting treatment options where the Railway Corridor is adjacent to a road. Rail infrastructure shall be considered High Consequence Infrastructure, Category H2.

2.3.3 Roadside Impact Severity Calculator – RISC (Austroads/TMR Section 4.5.7)

Not Accepted

The TMR Road Design Manual Benefit Cost Ratios (BCRs) limits and the Roadside Impact Severity Calculator (RISC) are not accepted.

Rail Safety National Law (Queensland) requires elimination or minimisation of risks to safety So Far As Is Reasonably Practicable (SFAIRP). Selecting a barrier that provides less protection than other options because it is cheaper is unlikely to satisfy that safety risks have been minimised SFAIRP.

The Proponent shall provide in the Design Report the safety argument that all possible controls were considered in accordance with the Safety Risk Acceptance Guideline MD-21-28. Where there are a number of options available for eliminating or minimising a risk, a record of discarded options shall be included in the Design Report for consideration by the Rail Infrastructure Manager and Road Authority.

2.3.4 Step B5 – Determine the barrier containment level required (Austroads/TMR Section 6.3.13)

Amendment

Taking into account the potential catastrophic consequences of an errant vehicle entering the rail corridor, the determination of barrier containment required shall be the result of a careful assessment exercise that takes into account the following:

- Traffic volumes and percentage of heavy vehicles. These shall be used to determine the design vehicle to be contained by the road safety barrier;
- Design speed;
- Crash history;
- Existing geometric alignment and whether there is a combination of factors that would cause a high likelihood of heavy vehicles becoming errant.

2.3.5 Step B6 – Choose the barrier type (Austroads/TMR Section 6.3.14)

Not Accepted

Flexible barriers systems, such as wire rope systems, are not accepted.

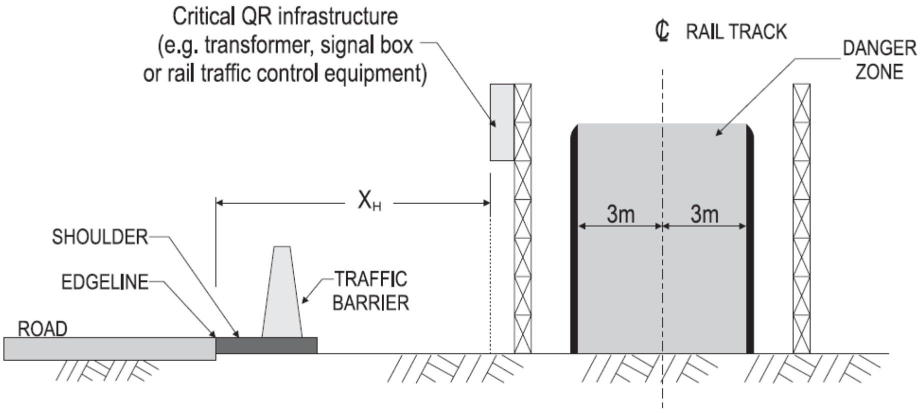
2.4 High Frequency Passenger Lines Barrier Selection Process

Where required by Section 2.1, reinforced concrete barriers shall be provided between the road and railway corridor in accordance with the following steps. A worked example of the process is given in Appendix 2.

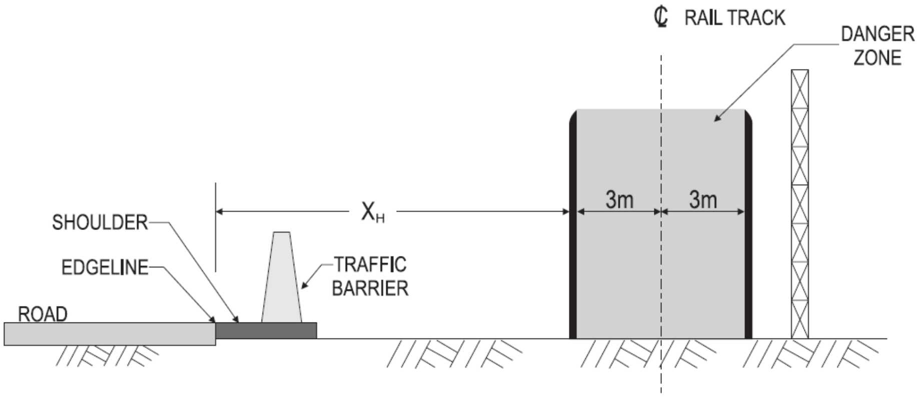
The road barrier should be located on the verge of the road shoulder, or batter slopes where the slope is less than1:10 and meets the conditions in the Austroads Design Guide and the TMR Road Design Manual - Commentary 12.

Step 1: Determine measured horizontal offset between road/rail interface

Determine the measured horizontal offset (X_H) from the edge line of the road to the closest railway infrastructure (either 3 m from the outside rail of the nearest railway track or to the nearest significant QR asset). If the offset varies along the road, different cross-section shall be considered in design. Figure 2 provides examples of Horizontal offset (XH) measurement and traffic barrier placement for different road/rail interface scenarios.



a) where critical QR infrastructure is between the road and track



b) without critical QR infrastructure is between the road and track

Figure 2: Examples of Horizontal offset (X_H) measurement and traffic barrier placement

Step 2: Apply slope adjustment factor to determine slope adjusted horizontal offset, X_S

The measured horizontal offset (X_H) shall be adjusted to take into account the slope of the embankment from the road corridor down to the rail corridor. No adjustment is necessary where the rail corridor is above the road corridor. For slopes between 1 to 4 and 1 to 2.5, the following equation shall be used to calculate the slope adjusted offset. If slope varies along the road, the factor shall be adjusted accordingly for each segment.

Slope adjusted horizontal offset $X_S = (X_H \times F_S)$

Where:

X_H = measured horizontal offset
F_S = slope adjustment factor (refer to Table 2)

Embankment Slope	F_s
Horizontal/Flat	1.00
Less than 1 to 4	1.00
1 to 4	0.38
1 to 3.5	0.29
1 to 3	0.17
1 to 2.5 or steeper	0.00

Table 2:Slope Adjustment Factors

For embankments with compound slopes, each section with a different slope shall be calculated individually and each slope adjusted offset shall be added to obtain the overall slope adjusted offset, X_S, such that:

Slope adjusted horizontal offset $X_S = \sum (X_{Hi} \times F_{Si})$

For example, for Figure 3 the slope adjusted horizontal offset is given by:

$$X_s = (X_{H1} \times F_{s1}) + (X_{H2} \times F_{s2})$$
$$= (X_{H1} \times 1.00) + (X_{H2} \times 0.17)$$

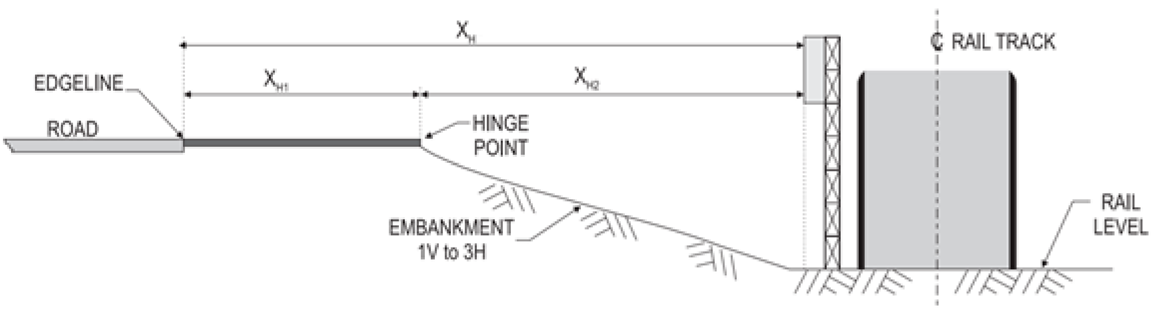


Figure 3: Horizontal Offsets

Step 3: Apply horizontal road curve adjustment factor

If the design radius of the road is equal to or less than 2000m, a horizontal curve adjustment factor, F_C, shall be applied to the slope adjusted horizontal offset determined in the previous step, X_S, to calculate the design offset, X_D, therefore:

The design offset, $X_D = (X_S \times F_C)$

Where:

X_S = slope adjusted offset

F_C = horizontal curve adjustment factor (Table 3)

X_D = X_H where the road is on a straight alignment or the radius is greater than 2000m and there is no slope adjustment.

Horizontal curve radii (m)	Design Speed Environment(km/h)						
	60	70	80	90	100	110	120
100	0.56	0.50	0.43	0.37	0.31	0.26	0.21
150	0.66	0.60	0.54	0.47	0.41	0.34	0.29
200	0.72	0.67	0.61	0.54	0.48	0.41	0.35
250	0.76	0.71	0.66	0.60	0.53	0.47	0.40
300	0.80	0.75	0.70	0.64	0.58	0.51	0.45
400	-	0.80	0.75	0.70	0.65	0.58	0.52
500	-	-	0.79	0.75	0.69	0.64	0.57
600	-	-	-	0.78	0.73	0.68	0.62
700	-	-	-	0.81	0.76	0.71	0.65
800	-	-	-	-	0.78	0.74	0.68
900	-	-	-	-	-	0.76	0.71
1000	-	-	-	-	-	0.78	0.73
1200	-	-	-	-	-	0.81	0.76
2000	-	-	-	-	-	-	0.84

Table 3: Horizontal Road Curve Adjustment Factor (Fc)

Note: The design speed environment is 10km/h above the posted speed limit of the road on the approach to the horizontal curve.

Step 4: Determine Road Status

The design speed and road classification shall be used to determine the road status as detailed in Table 4. The Road Authority may specify a Road Status to be used for a location or project.

Road-Status	Description	Design Speed Range(km/h)[1]	Indicative Traffic Volumes[2] (veh/day)
1A	Freeway, motorway or highway, and High Volume Heavy Vehicle[3] routes	80 to 120	>45,000
1B	Freeway, motorway or highway, and Low Volume Heavy Vehicle routes	80 to 110	
1C	Arterial or Sub-arterial Roads and Low Volume Heavy vehicle routes.	60 to 80	>10,000

Road-Status	Description	Design Speed Range(km/h)[1]	Indicative Traffic Volumes[2] (veh/day)
2A	Arterial, Sub-arterial connection roads and High Volume Heavy Vehicle[3] routes. Rural highways and High Volume Heavy Vehicles[3] routes.	80 to 110	
2B	Rural highways and Low Volume Heavy Vehicles routes Rural connection roads	80 to 100	>10,000 2500 – 15,000
2C	Trunk roads or Collector roads	60 to 80	1000 – 15,000
3	Residential Street, or Local or Property Access	50 to 70	<1000

Table 4: Road Status

Note:
1. The design speed environment is 10km/h above the posted speed limit of the road on the approach to the horizontal curve.
2. Traffic volumes are indicative because typical traffic flows for some functional classifications will differ significantly between major south-east Queensland urban areas and regional urban areas.
3. High Volume of Heavy Vehicles is where the percentage of heavy vehicles is 10% or greater.

Step 5:Determine the road barrier test level and height

Table 5 shall be used to select the appropriate barrier type and design height, using the rail and road status, and design offset, X_D.

Road /Rail corridor characteristics / Design Offset, XD (m)	1A-HFP	1B-HFP 2A-HFP	1C-HFP 2B-HFP 1A-MCP 1A-MCG	1B-MCP 2A-MCP	2C-HFP 1C-MCP 2B-MCP 1B-MCG 2A-MCG 1A-SP 2A-SP	2C-MCP 1C-MCG 2B-MCG 1B-SP 1C-SP 2B-SP 1A-SG 2A-SG	3-HFP 2C-MCG 2C-SP 1B-SG 1C-SG	3-MCG 2B-SG 2C-SG	3-MCG 3-SP 3-SG
≤4	TL6 1.8	TL6 1.5	TL6 1.5	TL5 1.5	TL5 1.5	TL5 1.1	TL4 1.1	TL4 1.1	TL4 1.1
5	TL6 1.8	TL6 1.5	TL6 1.5	TL5 1.5	TL5 1.5	TL5 1.1	TL4 1.1	TL4 1.1	TL4 0.92
6	TL6 1.8	TL6 1.5	TL6 1.5	TL5 1.5	TL5 1.5	TL5 1.1	TL4 1.1	TL4 0.92	
7	TL6 1.5	TL6 1.5	TL5 1.5	TL5 1.5	TL5 1.5	TL4 1.1	TL4 0.92		
8	TL6 1.5	TL5 1.5	TL5 1.5	TL5 1.5	TL5 1.1	TL4 1.21			
9	TL5 1.5	TL5 1.5	TL5 1.5	TL5 1.1	TL5 1.1	TL4 0.92			
10	TL5 1.5	TL5 1.5	TL5 1.5	TL5 1.1	TL5 1.1				
11	TL5 1.5	TL5 1.5	TL5 1.1	TL5 1.1	TL4 1.1				
12	TL5 1.5	TL5 1.1	TL5 1.1	TL5 1.1	TL4 1.1				
13	TL5 1.1	TL5 1.1	TL5 1.1	TL5 1.1	TL4 1.1				
14	TL5 1.1	TL5 1.1	TL5 1.1	TL4 1.1	TL4 0.92				
15	TL5 1.1	TL5 1.1	TL4 1.1	TL4 1.1					
16	TL5 1.1	TL5 1.1	TL4 1.1	TL4 1.1					
17	TL5 1.1	TL5 1.1	TL4 1.1	TL4 0.92					
18	TL5 1.1	TL4 1.1	TL4 1.1	TL4 0.92					
19	TL4 1.1	TL4 1.1	TL4 0.92						
20	TL4 1.1	TL4 1.1	TL4 0.92						

Road /Rail corridor characteristics	1A-HFP	1B-HFP 2A-HFP	1C-HFP 2B-HFP 1A-MCP 1A-MCG	1B-MCP 2A-MCP	2C-HFP 1C-MCP 2B-MCP 1B-MCG 2A-MCG 1A-SP 2A-SP	2C-MCP 1C-MCG 2B-MCG 1B-SP 1C-SP 2B-SP 1A-SG 2A-SG	3-HFP 2C-MCG 2C-SP 1B-SG 1C-SG	3-MCG 2B-SG 2C-SG	3-MCG 3-SP 3-SG
21	TL4 1.1	TL4 1.1							
22	TL4 1.1	TL4 1.1							
23	TL4 1.1	TL4 0.92							
24	TL4 1.1	TL4 0.92							
25	TL4 0.92								
26	TL4 0.92								
27	TL4 0.92								
28									
29									
30									
31							**Note:** Light Green shaded area denotes that a barrier may be required where directed by the Road Authority or Rail Infrastructure Managers as determined by a risk assessment. Refer to Section 2.6.4		
32									
33									
34									
35									

Table 5: Road / Rail interface barrier selection – Concrete Barriers

Step 6:Road barrier design parameters

Road barriers shall be designed for the loads described in Table 6.

Barrier Performance Level	Height (m)	Effective height, H_e (m)	Transverse Load (kN)	Vehicle Contact Length (m)***
TL4	0.92	Refer to TMR document "Accepted Road Safety Barrier Systems and Devices"		
TL4	1.1	Refer to TMR Design Criteria for bridges and Other Structures February 2021		
TL5	1.1	Refer to TMR document "Accepted Road Safety Barrier Systems and Devices"		
TL5	1.5	1.40	600	2.4 (AS 5100.2 Table12.2.2)
TL6	1.5	1.40	1200	2.4 (AS 5100.2 Table A2)
TL6**	1.8	1.75	750	2.4 (AS 5100.2 Table A2)

Table 6:Road barrier design parameters

Notes: * 44 t articulated van (excluding tanker)

** 36 t articulated tanker

*** Length of barrier that vehicle load is distributed over.

Note that, for TL4 barriers (height 1.1m) and TL6 barriers (heights 1.5, 1.8m) there are no proprietary barriers or standard designs available in Australia. Advice on their design shall be obtained from the Road Authority, where relevant, or a competent Registered Professional Engineer Queensland. The design should be in accordance with:

- TMR's Design Criteria for Bridges and Other Structures Manual;
- AS 5100.2-2017;
- AS 3845.1-2015.

2.5 Road Bridge Over Railways Barrier Selection and Design

Suitable reinforced concrete barriers shall be provided over the full width of the railway corridor on both sides of road bridges over railways and on bridge approaches (the length of the approach barrier shall be in accordance with AS 5100). The future rail and road status shall be taken into consideration in the barrier selection process and the bridge designed accordingly to also accommodate future barrier requirements.

Step 1: Determine road bridge overpass status

The design speed (i.e. the posted speed plus 10km/h) and road classification shall be used to determine the road status. Refer to Table 4.

Step 2: Determine the bridge barrier test level and height.

Table 7 shall be used to select the appropriate bridge barrier type and height, using the rail and road status.

Road Status	Rail Status				
	HFP	MCP	MCG	SP	SG
1A	1.8 (Special)	1.5 (Special)	1.5 (Special)	1.5 (Medium)	1.2 (Medium)
1B	1.5 (Special)	1.5 (Medium)	1.5 (Medium)	1.2 (Medium)	1.1 (Regular)
1C	1.5 (Special)	1.5 (Medium)	1.5 (Medium)	1.2 (Medium)	1.1 (Regular)
2A	1.5 (Special)	1.5 (Medium)	1.5 (Medium)	1.5 (Medium)	1.2 (Medium)
2B	1.5 (Special)	1.5 (Medium)	1.2 (Medium)	1.2 (Medium)	1.1 (Regular)
2C	1.5 (Medium)	1.2 (Medium)	1.2 (Medium)	1.1 (Regular)	1.1 (Regular)
3	1.1 (Regular)	1.1 (Regular)	1.1 (Regular)	1.1 (Regular)	1.1 (Regular)

Table 7: Select bridge barrier criteria

Note: 1. [1.1 (Regular)] denotes the barrier is 1100mm high, measured from the edge of the adjacent road lane pavement level with a barrier performance level "Regular".

Step 3:Select bridge barrier parameters

Design bridge barrier for loads shall be in accordance with Table 8.

Bridge barrier performance Level	Minimum effective barrier height (m)	Transverse Load (kN)	Vehicle Contact Length (m)***
Regular	**1.1**	300	1.2 (AS 5100.2 Table12.2.2)
Medium	**1.2**	600	2.4 (AS 5100.2 Table 12.2.2)
Medium	**1.5**	600	2.4 (AS 5100.2 Table 12.2.2)
Special*	**1.5**	1200	2.5 (AS 5100.2 Table A2)
Special**	**1.8**	750	2.4 (AS 5100.2 Table A2)

Table 8: Bridge Barrier Design Parameters

Notes: * 44 t articulated van (excluding tanker)
** 36 t articulated tanker
*** Length of barrier that vehicle load is applied over.

Step 4:Barrier System and Design

In addition to the barrier design parameters required by this Specification, the designer shall select and design a barrier in accordance with:

- TMR Road Design Manual;
- TMR Design Criteria for Bridges and Other Structures Manual;
- AS 3845.1-2015 Road safety barrier systems and devices Part 1: Road safety barrier systems;
- AS 5100.2:2017 Bridge Design Part 2: Design Loads;
- AS 5100.5:2017 Bridge Design Part 5: Concrete.

The barrier system documentation in accordance with AS 3845.1 Section 2 shall submitted with the Design Report for acceptance by the Rail Infrastructure Manager and Road Authority.

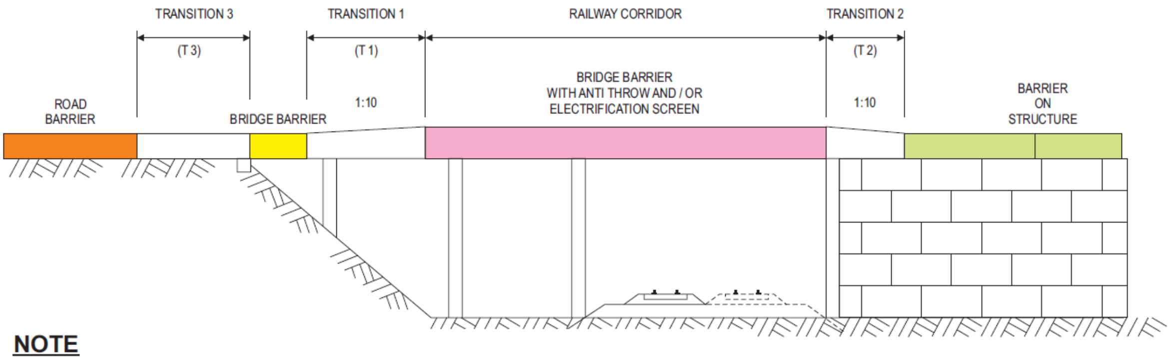
Step 6: Transition barrier design

The designer shall provide bridge barriers transitions in height and stiffness between the bridge barrier and the road barrier in accordance with:

- where on a bridge or structure, the TMR Design Criteria for Bridges and Other Structures Manual;
- where on an approach to a bridge or structure, the TMR Road Design Manual and the Austroads Design Guide.

Figure 4 shows the transition between all barrier types on a road bridge.

The most adverse M*, V* and T* effects shall be determined. Load cases shall show the transverse loading effects with the required effective height, transverse load and vehicle contact length. A load case shall be applied separately to each end of the transition segment.



NOTE

T1 = TRANSITION IN HEIGHT 1(v) TO 10(h)
T2 = TRANSITION IN HEIGHT 1(v) TO 10(h) AND IN STIFFNESS
T3 = TRANSITION IN STIFFNESS

Figure 4: Barrier Transition for road bridge over railway corridor (typical bridge elevation)

2.6 Adjustment Considerations

2.6.1 Barrier Design

AS 5100.1 Table 14.4 shows the controlling strength of the test vehicles, associated barrier performance levels and MASH Test Levels (TL). The test levels range from TL2/low performance barrier to TL6/special performance barrier. Special performance barriers are nominated by AS 5100.2 Table A2 and A3 and include 36 t and 44 t articulated van and tanker.

Barriers shall be designed to contain any part of the vehicle, its load and/or debris resulting from the collision and remnants of any secondary collisions, within the road corridor. The design shall take into consideration:

- Strength of the barrier to stop the vehicle or its load penetrating the barrier;
- Barrier height to minimise the risk of the vehicle or its load being propelled over the barrier;
- Containment of debris from any secondary vehicle collisions within the road corridor;
- Limiting the impact of any fire within the road corridor from adversely impacting on railway operations;
- Fire in either corridor can impact both the railway and road corridors from excessive smoke, and can damage infrastructure or in larger fires, power to the railway may be required to be switched off due to safety issues.

Typically, barriers shall be located within the road corridor on the edge of the road shoulder unless directed otherwise by the Road and Rail Infrastructure Managers. Where the railway is located above the road, a single slope barrier may be incorporated into the base of the embankment or retaining wall to redirect a vehicle and shield the embankment/retaining wall.

Where the road is subject to flooding, and an afflux will have an adverse effect on road users and adjacent property owners, steel or other barrier types may be used in leu of concrete barriers where approved by the Road Authority and Rail Infrastructure Manager.

2.6.2 Anti-throw and Electrification screens

Anti-throw screens are required on all road bridges, bike path and foot bridges over a railway corridor. In addition, electrification screens may be required where the railway is electrified. For requirements in relation to these screens, refer to Civil Engineering Technical Requirement CIVIL-SR-008 Protection Screens.

The additional barrier height should not be modelled for the purposes of meeting the requirement of this specification, as it is not required for vehicle redirection.

2.6.3 Change in Use of Existing Road and/or Rail

Where a change of use of the Road or Railway affecting the safety or effectiveness of an existing road/rail interface barrier is identified by either the Rail Infrastructure Manager or Road Authority, the party that has experienced the change should re-evaluate the existing road/rail interface in accordance with this specification. For example; if the Road Authority becomes aware that a nearby industrial development has resulted in an increase in the volume of heavy vehicles, then the road authority should re-evaluate the road/rail interfaces barriers.

Where the re-evaluation identifies that there is a non-compliance with this specification:

- the party should inform the other interface party, and
- non-compliance should be addressed.

2.6.4 Special Cases

Where there are hazards or environmental factors that require that are not addressed during the design process, an assessment shall be undertaken to determine if a different performance level barrier or height is required.

Example of situation where an assessment should be undertaken include:

- road adjacent to high risk facilities (railway control system building, electrical substations);

- roads with a high centre of gravity vehicles. (cattle yards and port access roads);
- high volume roads with low percentage of Commercial Vehicles (South East Freeway – Logan Road to Riverside Expressway).

Other factors which may result in or require barriers in excess of this specification include:

- the original design standard compared to current standard (The existing road would have been designed to the standard at the time);
- the condition of road (i.e. poor condition or issues that may increase the likelihood of errant vehicles entering the rail corridor);
- the potential for aqua planing.

The designer shall undertake a risk assessment for these parameters to determine an appropriate design standard and demonstrate that risks to safety are minimised So Far As Is Reasonably Practicable (SFAIRP).

Where a barrier with a lower level of containment than required by this Specification is proposed, an application for a departure, or derogation for temporary work, against this specification shall be submitted to the Discipline Head Track and Civil for approval. The submission shall demonstrate:

- in accordance with the Safety Risk Acceptance Guideline MD-21-28 that:
  - risks to safety are minimised So Far As Is Reasonably Practicable (SFAIRP);
  - the increased cost of the compliant barrier is grossly disproportionate to the increase in safety benefit; and
- acceptance from the Road Authority.

3 Terms and definitions

The following key terms and definitions are unique to this Specification. Please refer to the Business Glossary for other terms not included in this section.

Term	Definition	Source[1]
Austroads Design Guide	Specifically refers to the Austroads Guide to Road Design Part 6: Roadside Design, Safety and Barriers (2010)	
Road Authority	The authority or owner of the road. For example TMR, a local government authority or port authority.	
Proponent	The party who puts forward a proposition or proposal for a project or upgrade.	
TMR	The Queensland department of Transport and Main Roads	
TMR Road Design Manual	Specifically refers to the Queensland Department of Transport and Main Roads (TMR) Road Planning and Design Manual Edition 2: Volume 3 Supplement to Austroads Guide to Road Design (2010) Part 6: Roadside Design, Safety and Barriers.	

[1] Where left blank, Source is not applicable.

4 Document history

Document Information

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Document Authoriser	Chief Executive Officer (CEO)
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*Contact for further information

Document Amendment History

Version	Date	Section(s) Amended	Summary of Amendment
1.0	18/03/2022	New	First release

5 Appendices

Appendix 1 – Related documents

Queensland Rail documents

Document type	Document title
Principle	MD-12-21 Rail Safety
Standard	MD-10-115 Civil - Level Crossing Safety
Strategy / Plan	N/A
Specification / Framework	N/A
Procedure	N/A
Instruction	N/A
Guideline	MD-21-28 Safety Risk Acceptance
Form / Template	N/A
Others	CIVIL-SR-008 Civil Engineering Technical Requirement - Protection Screens

Appendix 2 – Example

Below is a worked example for the selection of a road/rail interface barriers in accordance Section 2.4 with for a fictious road upgrade. This process shall be applied along the length of the road adjacent to the railway corridor.

Example

A road upgrade is proposed on a section of the Highway adjacent the Mt Isa Line (Great Northern Railway). The Rail Infrastructure Manager requires that the barrier be design accordance with Section 2.4. The road the road has a high volume of heavy vehicles and the upgrade will have a posted speed of 100km/h and hence a design speed of 110km/h.

At one location of the upgrade the railway is located at the base of a 1 to 3 embankment. The offset from the edge-line of the road to the railway infrastructure is 6.5m and the distance from the top of the embankment to the railway infrastructure is 4.0m. At this location the road also will have a 600m horizontal curve.

Rail Traffic:

Queensland Rail has the requirement that the following Rail Traffic to be considered:

- Passenger Trains – Inlander;
- Main goods or mineral trains.

Section 2.2: Determining rail status

There are three types of rail traffic that need to be considered in this example:

- Passenger Trains;
- The line or system.

The most onerous outcome shall be applied.

The Passenger Trains

The Inlander operates on this section, therefore rail status “SP” should be considered.

The line or system

The Mt Isa Line has a rail status of “MCG”.

Step 1: Determining the measured horizontal offset between road/rail interface

The Horizontal offset is 6.5 m (X_H). However, as shown in Figure 1, there is

- a flat section between the edge line and the top of embankment of 2.5 m (X_{H1});
- a sloped section between the top of embankment 4.0 m(X_{H2}).

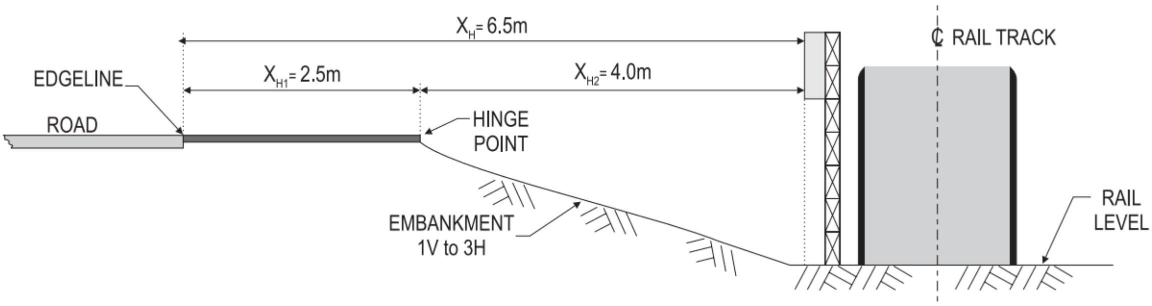

Figure 5: Road/Rail interface Geometry

Step 2: Applying slope adjustment factor to determine slope adjusted horizontal offset, X_S

The appropriate slope adjustment factor (F_s) from Section Table 2 is applied to the offset then summed.

Therefore:

$$X_S = \sum (X_{Hi} \times F_{Si})$$
$$= (X_{H1} \times F_{S1}) + (X_{H2} \times F_{S2})$$
$$= (2.5 \times 1.00) + (4.0 \times 0.17)$$
$$= 3.18\text{m}$$

Step 3: Applying horizontal road curve adjustment factor

The horizontal road curve adjustment factor is applied from Table 3 for the horizontal curve radius on the road of 600 m and the design speed of110 km/h to calculate the design offset X_D:

Therefore:

$$X_D = (X_S \times F_C).$$
$$= (3.18 \times 0.68) = 2.16\text{m}$$

Step 4: Determining road status

Using Table 4 the road is a rural highway and has a high volume (10% or greater) of heavy vehicles. Therefore, the status is 2A

Step 5: Determine the road barrier test level and height

Using Table 5, for 2.16m off set the Barrier Level is:

- TL5 with a height of 1.5 for Rail Status SP;
- TL5 with a height of 1.5 for Rail Status MCG.

For each Rail Status the barrier is TL5 with a height of 1.5. If the barrier was different for each Rail Status the highest level of barrier protection shall apply,

Appendix 3 – Determining Rail Traffic Volumes

When using rail traffic volumes to determine the Rail Status in Table 1, the following shall be considered:

- Proposed and planned increases in rail operations;
- Seasonal rail traffic, including:
  - harvesting seasons (i.e. wheat, sugar, etc.);
  - weather affecting rail operations (i.e. wet seasons);
  - annual seasonal events requiring an increase in passenger services for a minimum of month (i.e. school holidays).

When determining rail traffic volumes on lines with seasonal rail traffic, rail traffic volumes should be taken for the month with the largest rail traffic volume. Traffic volumes for that month should be:

- averaged over a minimum of 5 years, or
- the maximum volume that has occurred for the years that seasonal traffic has been operating on the line, or
- for where new seasonal traffic is proposed, proposed traffic volumes plus 10%.

Rail traffic data may be obtained from Queensland Rail.

Example

This example demonstrates how traffic volume may be determined. It expands on the example from Appendix 2 using traffic number from the Mt Isa Line (the Great Northern Line). It should be noted, that the use of traffic volumes to determine rail status for the Mt Isa Line is not permitted by Section 2.2 and Table 3.

The average number of services for each month over the last 5 years is shown in Table 8.

5 year Avg of Monthly Services	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cloncurry - Flynn Junction	9	99	161	141	162	138	174	158	156	123	95	146

Table 9: Example Rail Traffic Volumes

Operational variations that may increase traffic shall be considered. Rail traffic on the Mt Isa line vary throughout the years depending on:

- the impact of the wet season which typically occurs from October to May;
- commodity prices.

Therefore, the traffic volumes in Table 8 have been averaged over five years for each month. To determine the number of trains per week, the month with the most train should be taken so that low traffic volumes that occur during the wet season are removed.

Therefore

$$N \text{ (trains per week)} = \text{Number of trains in July} \div 4.333\text{(wk/mth)}$$
$$= 174 \div 4.333$$
$$\approx 40 \text{ trains per week}$$

So, the rail status is “MCG” in accordance with Table 1.