Code of Practice
Bridge approach barriers

1. Scope and application

BTN002 Bridge approach barriers states VicRoads' requirements for the design of bridge approach and departure barriers. In particular, it includes a methodology for determining the length of bridge approach barriers to satisfy the requirements of AS5100.1 Clause 14.6.3.

Bridge Technical Notes are a Code of Practice. Compliance with Bridge Technical Notes is mandatory.

BTN002 Bridge approach barriers is to be read in conjunction with the following documents:

- BTN001 Bridge traffic barriers
- Austroads Guide to Road Design Part 6 and the corresponding VicRoads Supplement

Other than as stated in this document and relevant VicRoads standard specifications, the provisions of AS5100:2017 shall apply. Where this document differs from AS5100:2017, its requirements override those of AS5100:2017.

2. Scope

Code of Practice BTN002-2017 covers the design of multiple performance level barrier systems:

- at bridge approaches
- at bridge departures

3. Terminology

Effective Clear Zone – Clear Zone derived from the Austroads Guide to Road Design modified by the corresponding VicRoads supplement.

Hazard – a rigid object (e.g. concrete bridge barrier, a bridge barrier end-post), steep non-drivable batter (steeper than 6:1), vertical drop, waterway, railway, road, or high occupancy land.

Gore – the triangular area (usually surfaced with asphalt and possibly hatched) situated at the point where exit or entry ramps diverge/converge with the main carriageway.

Bridge influence - the effect that the presence of a bridge and the use of rigid or semi-rigid bridge barriers have on the hazard faced by road-users approaching the bridge – for example the risk of pocketing and of a vehicle impacting the end of the bridge barrier. This necessitates higher performance level roadside barriers on the bridge approaches than would be required in the absence of the bridge.

4. Design

4.1. General

The design of bridge approach barriers must satisfy the general requirements of AS5100.1:2017 Clause 14.6.3.

If the bridge approach barrier is connected to a road side barrier, the road side barrier must be continuous with the bridge approach barrier system. A transition from the flexible roadside barrier to the more rigid bridge approach barrier must be provided at the junction of the two systems. The roadside barrier may overlap the end of the bridge approach barrier subject to appropriate allowance for its working width – e.g. in the case of Wire Rope Safety Barrier.

4.2. Performance level

The required bridge barrier performance level is determined in accordance with COP BTN001-2017.

The performance level of the bridge approach barrier is then stepped-down incrementally in accordance with the methodology stated in Appendix A to the point where it ends or joins the roadside barrier.

The initial length of bridge approach barrier adjacent to the bridge is assigned the same performance level as the bridge barrier.

4.3. Length of bridge approach barrier

The total length of bridge approach barrier from the end of the bridge barrier to its termination or connection to the roadside barrier is determined in accordance with the methodology given in Appendix A.

The methodology combines consideration of the hazards presented by the bridge and the bridge barrier (bridge influence) and the embankment geometry at the bridge approaches and includes consideration of several specific cases. The contribution of the embankment hazard is quantified in terms of the Effective Clear Zone.

4.4. Design for strength

Bridge approach barriers must be designed in accordance with the requirements of COP BTN001-2017 Bridge barriers together with AS5100.1:2017 and AS5100.2:2017 for the appropriate performance level.

The bridge approach barrier, its connections and supporting systems shall be designed as a progressive strength system to limit the damage to the supporting system and the need for reconstruction which could arise from a collision.

Concrete bridge approach barrier and foundation systems may be designed as rigid or semi-rigid systems.

Full continuity shall be provided throughout the length of the rigid bridge and bridge approach barrier systems in the lateral direction and with the foundations. In the case of steel railings, splices shall be provided by full penetration butt welds.

Non-rigid roadside barriers shall be designed in accordance with VicRoads Supplement to the Austroads Guide to Road Design.

4.5. Geometry and appearance

The height and shape requirements stated in COP BTN001:2017 shall apply.

At junctions between barriers of different performance level the top of the lower performance barrier shall slope upwards at a gradient of 1:10 to meet the adjacent higher barrier in accordance with AS5100.1 Cl14.6.3.

4.6. Additions

If it is necessary to mount a noise wall or other structure on the bridge approach barrier, this must be reflected in the design of the bridge approach barrier and its foundations. The following requirements must be met:

- the design of the bridge approach barrier must include the load effects arising from the addition
- the addition must not modify or affect the function of the bridge approach barrier
- the geometry of the additional structure must comply with the working width requirements of the AGRD Part 6.

4.7. Single carriageway bridges

4.7.1. Approaches

The length of bridge approach barrier on the left (near) side shall be in accordance with 4.3 of this document.

Approach barriers on the right hand (off) side approach shall have the same length as the left hand (near) side barriers.

4.7.2. Departures

Single carriageway bridges with one-way traffic shall be provided with departure barriers consistent with roadside hazards on the departure side of the bridge. The required length shall be determined by consideration of risk relative to the roadside hazards on the departure side of the bridge.

Departure barriers for single carriageway bridges with two-way traffic are to have the same length and performance levels as determined for the approach barriers (refer to 4.7.1).

4.8. Divided carriageway bridges

4.8.1. Approach barriers - left (near) side

The length of bridge approach barrier on the left (near) side shall be in accordance with 4.3 of this document.

4.8.2. Approach barriers - right (off) side

- median width > ECZ - length of approach barrier is calculated using the procedure in 4.3 to protect the ECZ width or 15m whichever is greater
- median < ECZ - the length of approach barrier is calculated using the procedure in 4.3 to protect the median width.

4.8.3. Departure barriers – central median

If an errant vehicle departing the bridge can impact the bridge approach barrier on the opposite carriageway, the following is required:

- double sided off-structure barriers shall be provided in accordance with the Austroads Guide to Road Design – Part 6 and VicRoads Supplement (see Figure B1)

  or

- the off-structure barrier on the departure side of the structure shall be extended to contain errant vehicles at a 15º divergence angle projected from the median side of the traffic (see Figure B1).

4.9. High risk areas

Site-specific consideration shall be given to the risk of a heavy vehicle leaving the roadway from the left-hand traffic lane (e.g. if the driver becomes incapacitated), bypassing the end of bridge approach barrier and failing to brake leading to encroachment into the:

- high-risk area under the bridge, particularly when this is a major roadway or railway, high use land area or deep water
- area beyond the right of way boundary

The risk-assessment shall consider the probable stopping distance of the errant vehicle having regard to the ground surface and weather conditions. For example, if the ground surface behind the barrier is flat or near flat, the probability of greater penetration is increased.

If there is a risk that an errant vehicle could bypass the bridge approach barrier and penetrate the high-risk area, additional provisions are required. This can be either a longer bridge approach barrier or a secondary barrier at the hazard or Right of Way boundary or a combination.

4.9.1. Gore areas

The presence and geometry of gore areas can limit the length of approach barrier. There may be a risk of a vehicle leaving the main carriageway and encroaching onto an entry

or exit ramp. Equally, vehicles on entry and exit ramps may encroach onto the main carriageway.

For sites where the required LOB is curtailed by the presence of a gore area, the bridge approach barrier shall be extended as far as possible and terminated with a proprietary attenuator at the gore area.

4.9.2. Side roads and other accesses

Special consideration shall be given to side roads or access to business or private properties within the length of bridge approach barrier. In these cases, the bridge approach barrier shall be designed to safely contain errant vehicles at all probable impact angles as far as is reasonably practicable.

Barriers at openings shall be curved in plan and shall extend either to join a roadside barrier on the side road or to a safe termination using proprietary components in such a fashion that the hazard due to an impact with the end of the barrier is minimised.

Appropriate rigid bridge barrier systems, shall be extended down freeway or major highway entrance and exit ramps a suitable distance to protect against errant vehicles penetrating the freeway or highway.

4.9.3. End treatments

Ends of approach and departure barriers shall either be:

- designed to ensure acceptable performance on impact at the required performance level for the vehicle(s) under consideration crashworthy
- protected by a suitable transitioned traffic barrier and/or proprietary impact attenuation device
- connected to a roadside barrier

Ends of rigid barriers that may be connected to and/or splay away from a non-rigid approach system shall be suitably terminated.

End blocks, for example, shall be detailed to ensure that the occupants of vehicles and others nearby are protected during an end-on impact.

The end treatment shall be in accordance with the relevant sections of the VicRoads Supplement to Austroads Guide to Road Design.

4.10. Benefit-cost analysis

In all cases, the effect of providing higher containment level barriers and the position of different levels of containment can be evaluated by a Benefit : Cost Analysis.

5. Other considerations

Anchor bolts and other fixings cast into concrete shall be designed to minimise any damage that might occur if the attached post or railing reaches its plastic capacity due to the effects of an impact.

Retrofitted bonded (adhesive) or mechanical bolts and fasteners shall not be used as holding-down bolts or to make connections between bridge-approach barrier components where they might be subject to impact forces or the effects of impact forces.

6. Foundations

Bridge approach barriers shall be provided with a foundation. The foundation shall have sufficient capacity to support the design loads appropriate to the required performance level as defined in AS5100.2:2017 as modified by this document.

7. Constructability and maintainability

The design shall include provisions to enable replacement of a severely damaged barrier.

Appendix A

The following steps describe the methodology for deriving the lengths of off-structure barriers at different performance levels to satisfy the requirements of Clause 3 of this document and Clause 14 of AS5100.1:2017.

A2 Effective Clear Zone (ECZ)

Clear Zone width (CZ) is derived from Part 6 V4.2.2.2 of VicRoads supplement to the Austroads guide to road design

ECZ is then derived using Part 6 V4.2.2.3 of VicRoads Supplement to the Austroads guide to road design.

A3 Length of off-structure barrier

The length of off-structure barrier (LOB) is calculated using a 15º divergence angle from the outside edge of the traffic lane as shown below.

LOB is rounded upwards to the nearest multiple of 6m.

A4 Approach barrier panel lengths

Determine the approach barrier performance level lengths in accordance with Table 1

TABLE 1 APPROACH BARRIER PANEL LENGTHS

Barrier PL on the bridge	**Length of high PL approach barrier**	**Length of medium PL approach barrier**	**Length of regular PL approach barrier**
High	LOB/3 [2]	LOB/3 [1]	LOB/3 [1]
Medium		LOB/2 [3]	LOB/2 [1]
Regular			LOB [1]

Notes

PL – Performance level

1 – The length of approach barrier shall be not less than 12m for each performance level.

2 – The minimum length of approach barrier shall be not less than 24m if crossing medium to high frequency passenger rail lines or good goods lines carrying noxious, flammable or large volumes freight, high volume roads, bridges over major roadways and 12 m for other cases. The total length of approach barrier performance level provision is then equal to (24 + 2xLOB/3).

3 – If the road carries more than 5 public service/tourist coaches per day, the minimum length of approach barrier shall be not less than 24m. Total length of approach barrier is then equal to (24 + LOB/2).

4 – The foregoing panel lengths are based on multiples of 6m.

A4.1 Orthogonal bridges

For an orthogonal bridge-crossing, the ECZ is projected at right angles from the end of the bridge which is either the end of the deck or, in an integral bridge, is defined as the exposed face of the face of abutment crosshead.

A4.2 Skew bridges

The ECZ is off-set from the edge of the trafficable lane and the intersection with the hazard (Refer to Figure B2 which illustrates the geometry for a skew bridge).

When the ROW boundary is within the ECZ, the road safety barrier beyond the minimum length of approach barrier required by Clause 4.3 shall be designed in accordance with the Austroads Guide to Road Design – Part 6 and VicRoads Supplement.

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Bridge Technical Notes are subject to periodic review and may be superseded

Appendix B

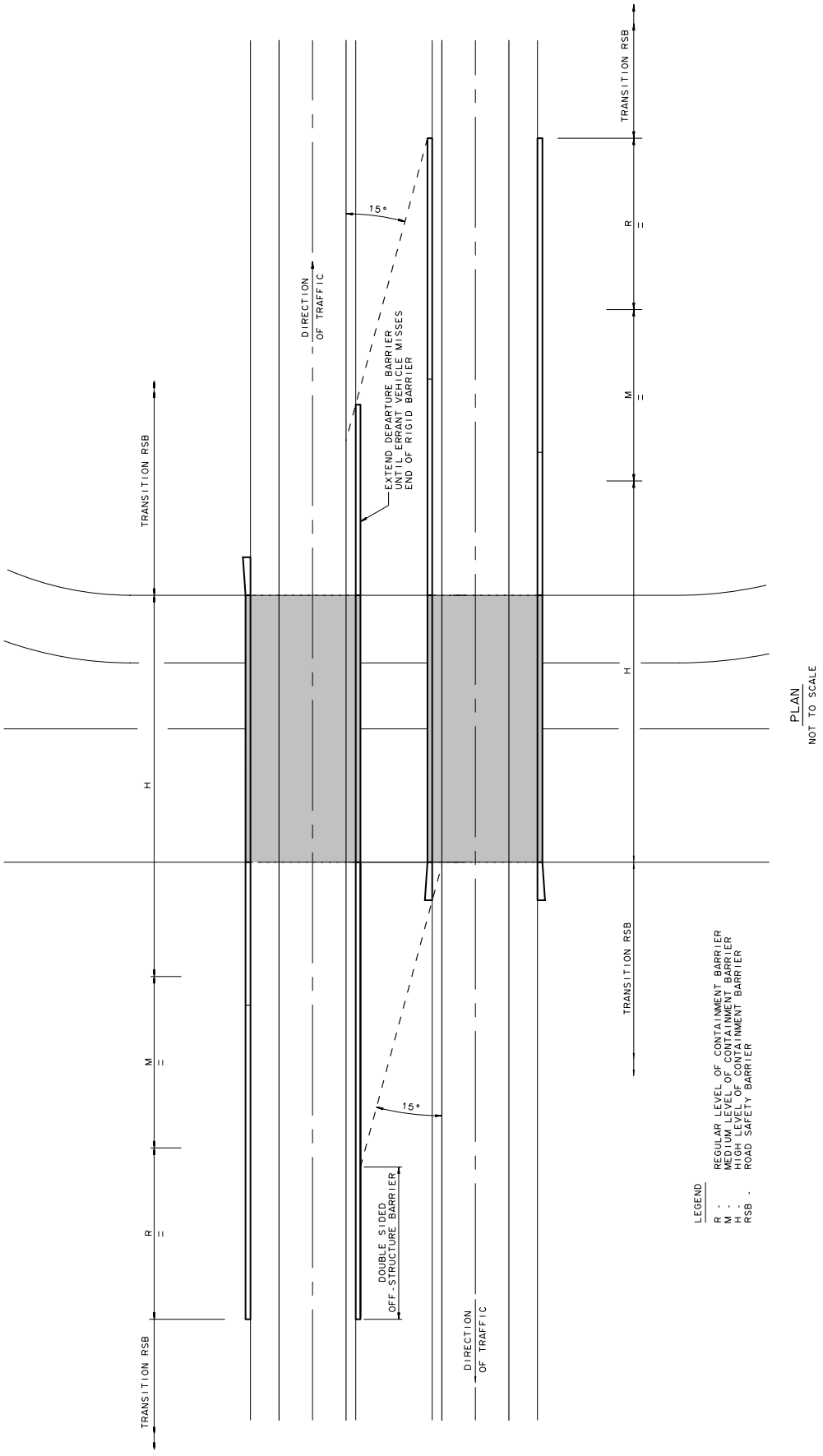

Figure B1 - Geometry of Departure Barriers

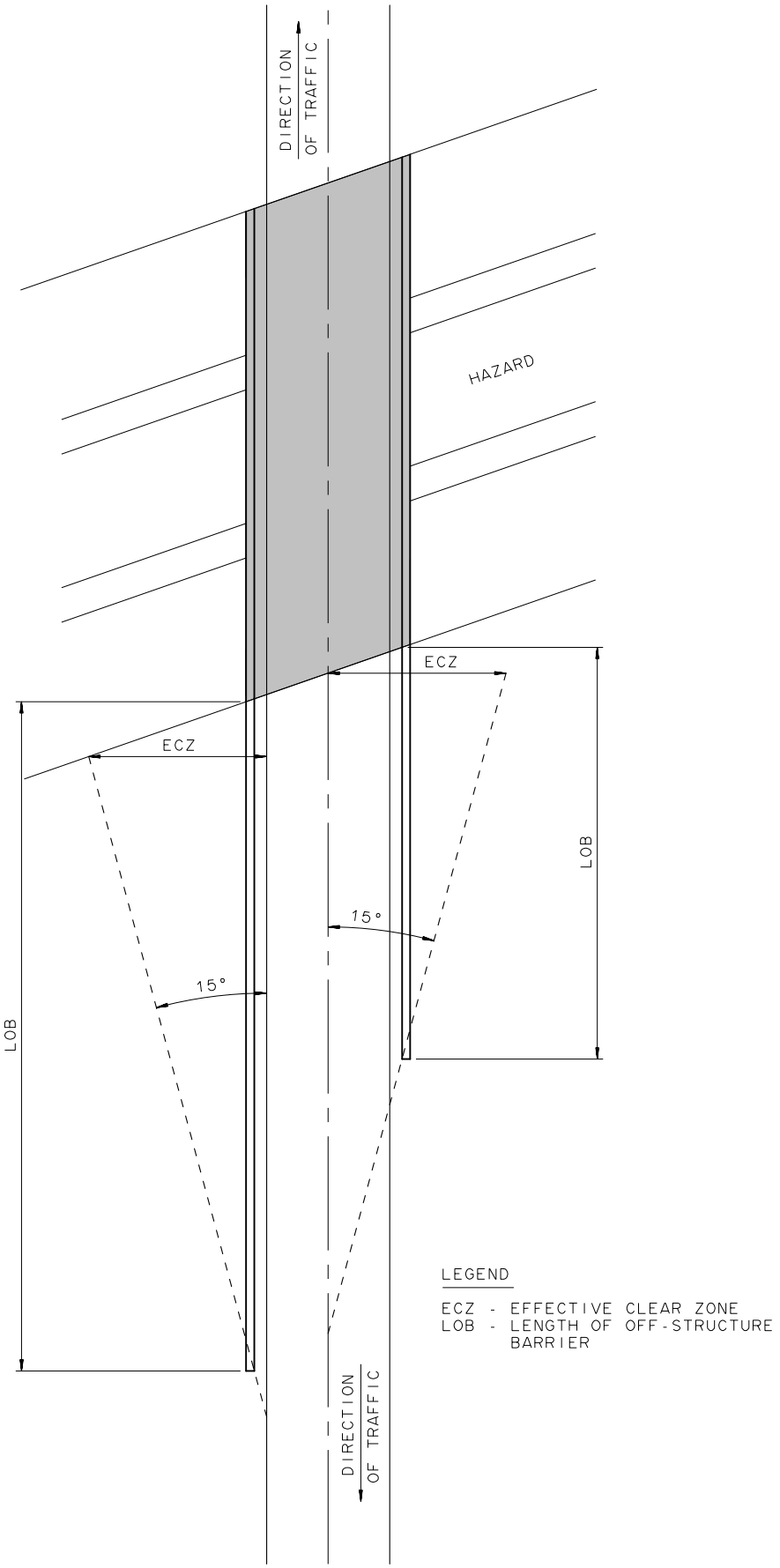

Figure B2 - Geometry of a Skew Bridge