RamShield®
TRANSITION

MASH TL3 Compliant

SafeDirection
CRASH BARRIER SOLUTIONS

safedirection.com.au

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Leading Safety

Successfully crash tested to MASH Test Level 3

Complies with AS/NZS 3845.1:2015 Road safety barrier systems and devices

Safe vehicle containment and redirection

Simplified Installation

Just 5.9m length, measured from the asymmetric transition

No nesting of the thrie-beam rail

No blocking pieces – just 235mm system width

No requirement for cast-in ferrules when connecting to concrete

Standard 1860mm RamShield® High Containment (HC) posts throughout the transition

1000mm thrie-beam rail height

Compatibility

Suitable for attachment to the Austroads concrete anchor block design

Suitable for attachment to CrocGuard® bridge/culvert barrier

Same installation height as RamShield® High Containment (HC)

Can be connected directly to RamShield® W-Beam or MSKT Terminals

1.0 Introduction

Wherever it is necessary to change from one type of barrier to another, or to physically join them together (e.g. a bridge barrier to a road barrier), the interface must be designed to ensure that the overall system will perform safely when impacted by a design vehicle.

The RamShield® Transition provides a smooth, snag-free connection between steel guardrail barriers and rigid barriers, such as at bridge parapets. The RamShield® Transition gradually increases stiffness of the system reducing the potential for vehicle pocketing.

2.0 RamShield® Transition Specifications

Compliance:	MASH Test Level 3
	AS/NZS 3845.1:2015
Standard post length:	1860mm
System width:	235mm
MASH TL3 Deflection:	0.5m

System Finish: Hot dip galvanised to AS/NZS 4680

3.0 Material Traceability

Safe Direction operates a quality management system, independently certified to the requirements of ISO 9001:2015.

A multi-stepped procedure is used by Safe Direction to verify the compliance of the material used in the production of RamShield® posts and thrie-beam guardrail to AS/NZS 1594.

Mill certificates and independent third-party laboratory test results are verified against Australian Standard guidelines recording the steel heat numbers, mechanical results and chemical composition.

Safe Direction product is then stamped during manufacture with a 4-digit number providing industry-leading traceability to the steel heat number. The format for stamping thrie-beam guardrails is:

Example: SD 9419 350 27

Where: SD = product from Safe Direction

9419 = the last 4 digits of the heat no.

350 = steel grade (i.e. HA 350)

27 = base metal thickness (i.e 2.7mm)

TEST CERTIFICATE BLUESCOPE STEEL

CHEMICAL ANALYSIS

Percentage of element by mass (L=Cast, P=Product, -S=Soluble, -T=Total, CF=Chemical Formula, n=Min, x=Max)

Item No	Heat / Unit No	NATA Lab	L/P	C	P	Mn	Si	S	Ni	Cr	Mo	Cu	Al-T
0010	6709419	0632	L	.157	.019	.74	<.005	.015	.016	.035	.004	.042	.034

Item No	Heat / Unit No	NATA Lab	L/P	Ti	B-T	N	Nb	Sn	V	CF1	CF2	CF3
0010	6709419	0632	L	<.002	<.0003	.0045	.001	.002	<.003	.29	.10	.00

CF1=C+ (MN/6) + ((CR+MO+V)/5) + ((CU+NI)/15) CF2=NI + CR + CU + MO CF3=NB + TI + V

MECHANICAL TESTING

Tensile AS 1391

Item No	Heat No	Tested Unit	NATA Lab	Cat	Loc	THICK mm	ReH MPa	Rm MPa	Lo mm	ELONGN %
0010	6709419	1H1F9690	0631	B	LQF	2.70	420	520	80	25
0010	6709419	1H1F9845	0631	B	LQF	2.70	390	500	80	22

ITEMS COVERED BY THIS CERTIFICATE

Item No	Heat No	Ordered Dimensions (mm)	No of Units	Mass (Tonnes)	Unit Identities
0010	6709419	740.0X2.70XCOIL	6	24.030	1H1H9291AA 1H1H9291BA 1H1H9291CA 1H1H9291DA 1H1H9292AA 1H1H9292CA

4.0 How the RamShield® Transition Works

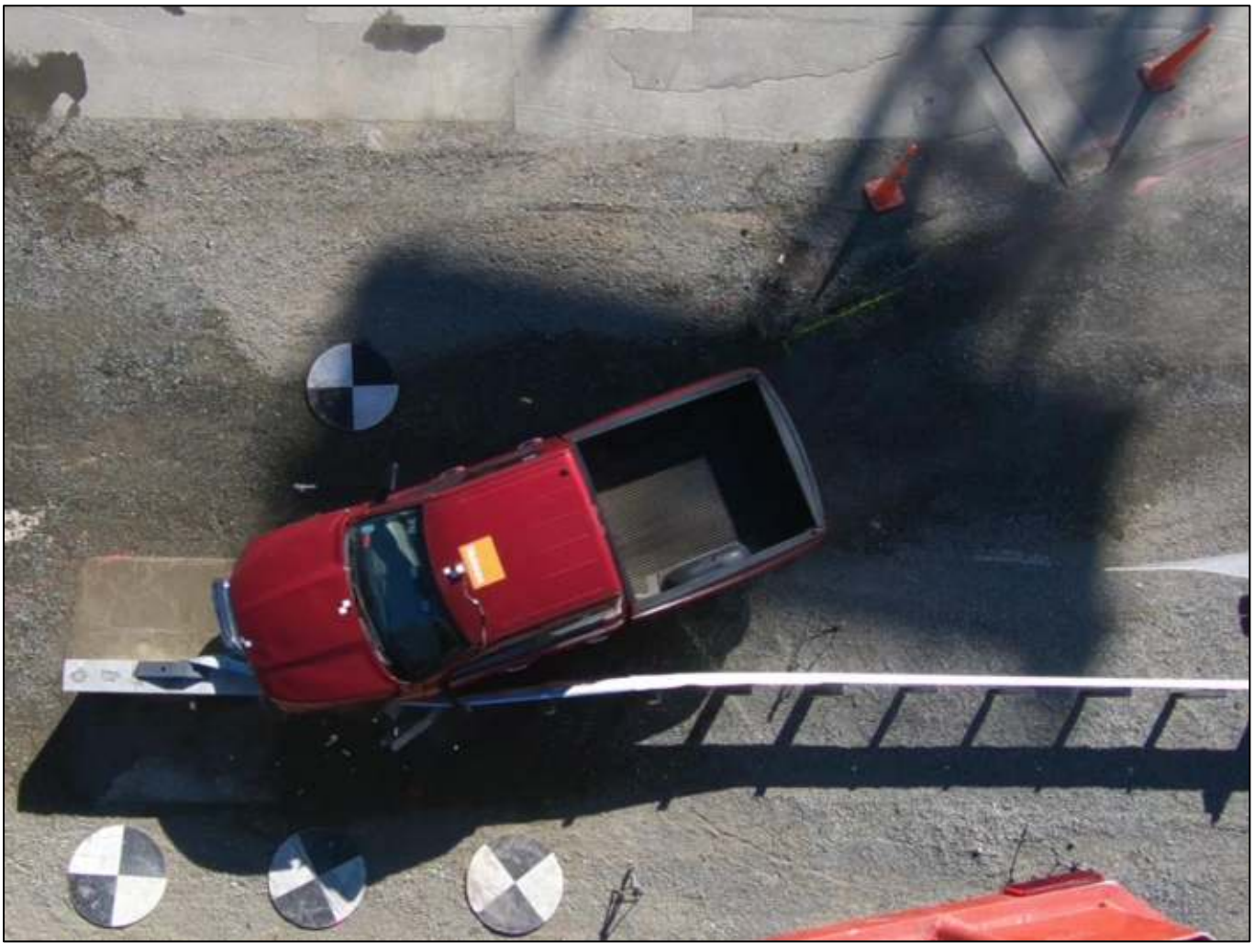
The RamShield® Transition features 3.5mm thick thrie-beam guardrail, eliminating the need for nesting rails. The posts are 1860mm RamShield® High Containment (HC) posts, which are the same C-post profile as used in Australian public domain guardrail systems.

The RamShield® Transition achieves a controlled redirection of errant vehicles by releasing the thrie-beam guardrail from the post at an optimal load to retain rail height, limit dynamic deflection and to allow the post to collapse without tripping the vehicle.

The separation of the rail from the post is achieved by a release tab incorporated into the C-post. The tab controls the release of the rail within the impact zone providing stable vehicle containment and redirection with minimal vehicle roll.

The C-posts collapse upon impact yielding proximate to the ground surface. The sectional strength of the C-post limits barrier deflection, an important design consideration when reducing the potential for vehicle pocketing.

The 1000mm thrie-beam rail height improves vehicle stability during containment and redirection.



5.0 Crash Test Performance

The RamShield® Transition has been fully crash tested and evaluated according to the specifications for Test Level 3 (TL3) of the AASHTO Manual for Assessing Safety Hardware (MASH). The MASH specification is an update to and supersedes NCHRP Report 350 for the purposes of evaluating new safety hardware devices.

MASH is also the basis of testing procedures for road safety systems as stated in *AS/NZS 3845.1: 2015 Road Safety Barrier System and Devices.*

The introduction of MASH follows changes to the vehicle fleet, researching of real-life impact conditions and updated criteria for evaluating barrier performance.

The MASH TL3 crash test matrix requires the following impacts:

- 2270kg pick-up truck travelling at 100km/h and 25°, and
- 1100kg passenger car travelling at 100km/h and 25°.

6.0 Design Considerations

6.1 Shy Line Offset

When safety barriers are located too close to traffic, drivers in the adjacent traffic lane tend to reduce speed, drive off-centre in the lane, or move into another lane.

Generally, there should be uniform clearance between traffic and roadside features. Uniform alignment enhances road safety by providing the driver with a certain level of expectation, thus reducing driver concern for and reaction to the roadside features.

The distance from the edge of the traffic lane beyond which a roadside feature will not be perceived as an obstacle and result in motorists reducing speed or changing lanes on the road is called the shy-line offset.

Where long continuous lengths of barrier are used, this shy-line effect is not so critical, especially if the commencement of the barrier can be gradually transitioned from beyond the shy-line.

Recommendations for the shy line offset are contained in Table 1.

Table 1: Shy Line Offset

Design Speed (km/h)	Shy Line Offset (m)
50	1.1
60	1.4
70	1.7
80	2.0
90	2.2
100	2.4
110	2.8

Source: Austroads Guide to Road Design Part 6

6.2 Flaring

Motorists are less likely to perceive roadside barriers to be a hazard if the barrier is introduced gradually to the roadside environment through the use of a 'flare'. The flare rate is the ratio of the length of the flared part of the barrier (measured parallel to the road) to the barrier offset.

Flaring the safety barrier system provides the following benefits:

- The end terminals can be positioned further from the travelled path reducing the potential for a head-on impact;
- The shy line effects where a hazard is close to the travelled path is minimised; and
- Flaring provides a gradual transition to a major hazard close to the roadway (such as a bridge parapet or railing).

The maximum flare rates that should be used on an approach to a road safety barrier are shown in Table 2. Following the guidelines of Table 2 ensures that the flare does not significantly increase the opportunity for high-angle impacts with the barrier.

Table 2: Flare Rate

Design Speed (km/h)	Flare Rate (within Shy Line Offset)	Flare Rate (outside Shy Line Offset)
50	13:1	7:1
60	16:1	8:1
70	18:1	10:1
80	21:1	11:1
90	24:1	12:1
100	26:1	14:1
110	30:1	15:1

Source: Austroads Guide to Road Design Part 6

The flare rate for end terminals may vary from those contained in Table 2. Please refer to specific Product Guides for allowable flare rates for end terminals.

6.3 Advance Grading

It is recommended that the area in advance of the RamShield® Transition be limited to a grading of 10H:1V to ensure that the vehicle's suspension is neither extended nor compressed at the moment of impact with the barrier.

6.4 Proximity to Batter Hinge Points

Space in the road corridor is premium. In an effort to maximise space for other infrastructure and landscaping, the proximity of the post to the batter hinge point is often reduced during the design process, without evidence or justification through crash testing.

Best practice ensures that the vehicle remains on the verge, that there is no damage to the batter following an impact and that the embankment provides adequate support to resist the impact loads.

The Austroads Safety Barrier Assessment Panel's preference is for the distance to the hinge point be sufficient to accommodate the barrier's design deflection and provide adequate lateral support for the system.

On constrained sites, please consult with Safe Direction for guidance on minimum distances and post embedment depth, noting that recommendations need to consider available distance to the hinge point, soil conditions and batter slope.

6.5 System Installed Height

The RamShield® Transition has been crash tested with the top of the thrie-beam guardrail 1000mm above ground level.

The thrie-beam guardrail is positioned approximately 30mm above the top of the post. This is an important design consideration for vulnerable road users.

The post mounting slot provides 45mm of height adjustment. The tolerance on system height is ± 20mm.

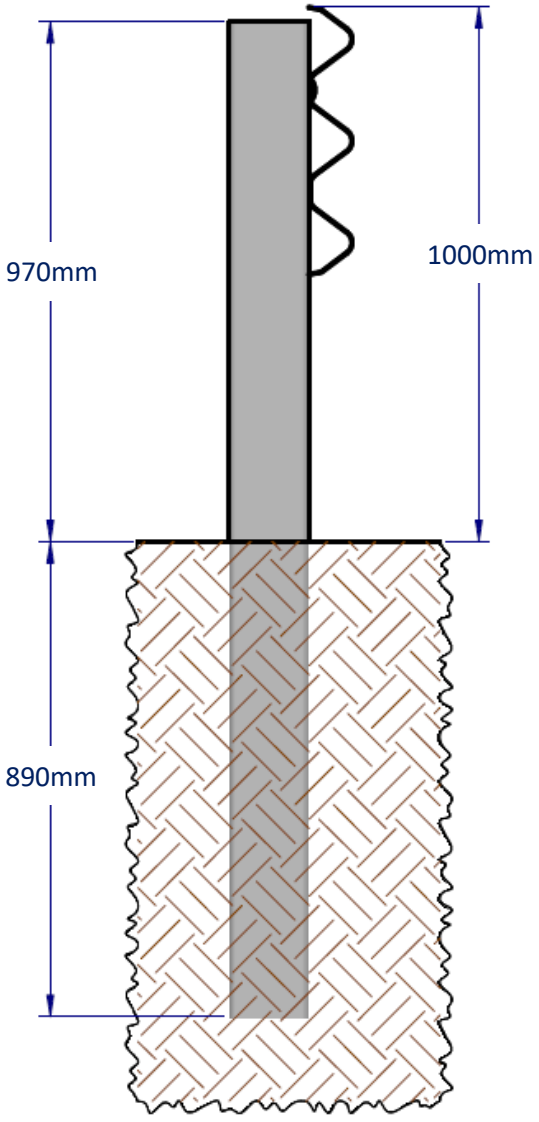


Figure 1: RamShield® Transition Post Embedment

6.6 The Asymmetric Transition

The use of an asymmetric transition is required to transition from thrie-beam to w-beam guardrail. The asymmetric transition panel is 1905mm long (nett laying length) and is available as an approach or departure configuration (viewed from the road centreline).

The asymmetric transition lowers the height to top of the thrie-beam rail by 200mm, making it compatible for use with RamShield® W-Beam guardrail and MSKT terminals, which are installed with a rail height of 800mm above ground level.

The w-beam end of the asymmetric transition can be connected directly to RamShield® W-Beam guardrail or a MSKT Terminal.

6.7 Connecting to RamShield® W-Beam

Typically, RamShield® W-Beam is installed with posts at 2m centres, however when connecting to the RamShield® Transition, the 4m prior to the asymmetric transition is installed with posts at 1m centres. This arrangement gradually stiffens the RamShield® W-Beam barrier as it transitions to thrie-beam.

Safe Direction w-beam guardrails are pre-punched at 1m centres to faciliate the reduced post spacing.

6.8 Connecting to RamShield® HC

The RamShield® Transition can be connected directly to RamShield® High Containment (HC) without an asymmetric transition piece.

The RamShield® Transition uses the same post as RamShield® HC and adopts the same system height, simplifying connection between the two systems.

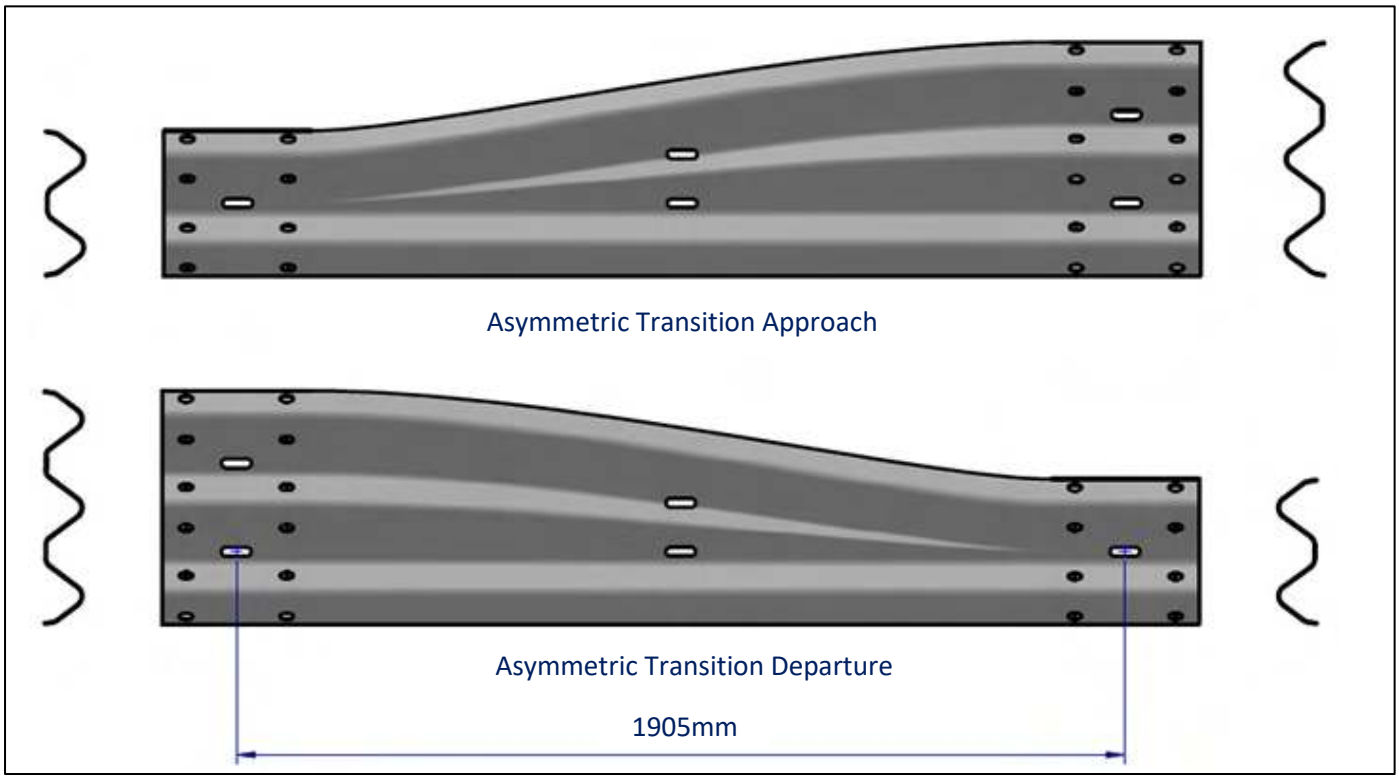


Figure 2: Asymmetric Transitions

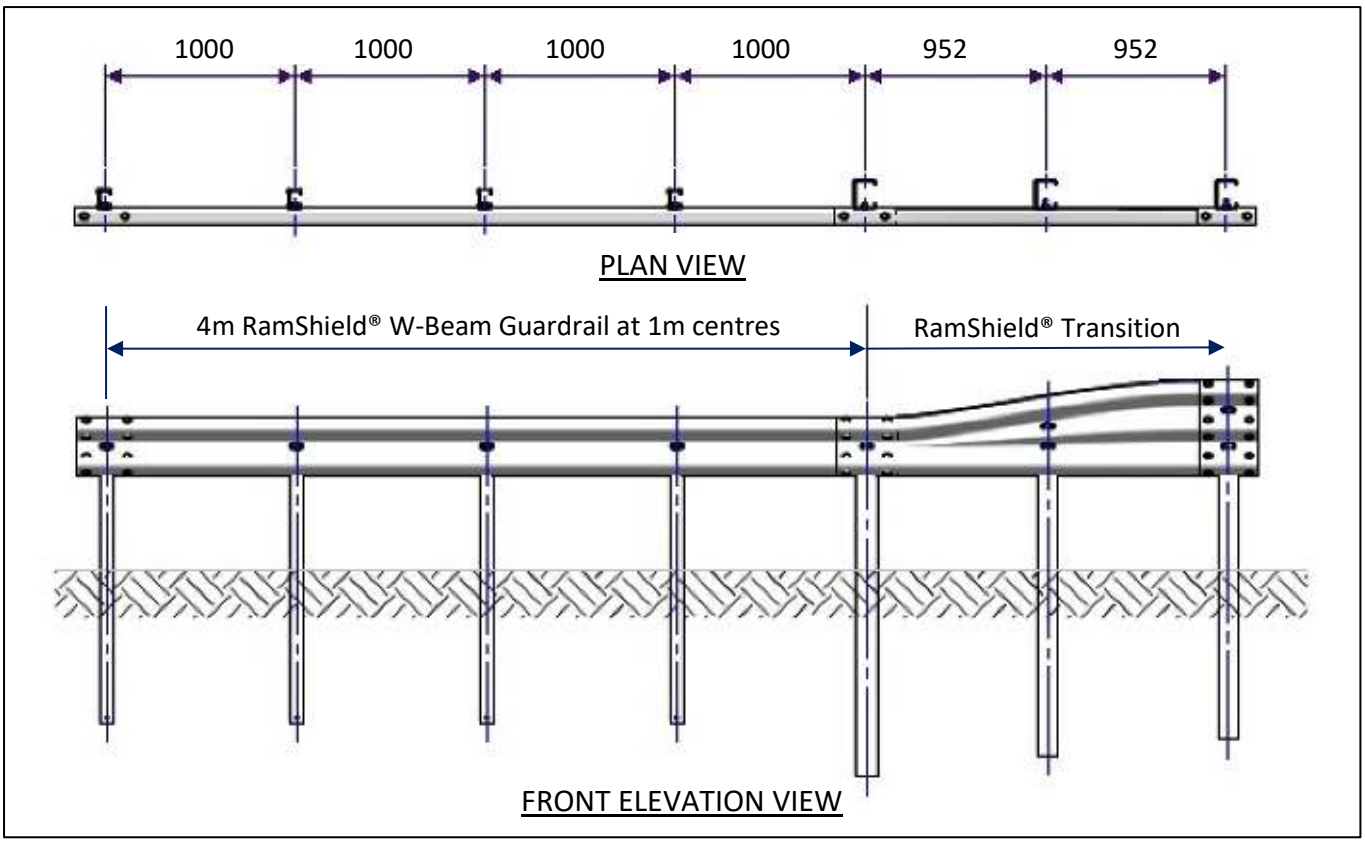


Figure 3: RamShield® Transition Connection to RamShield W-Beam

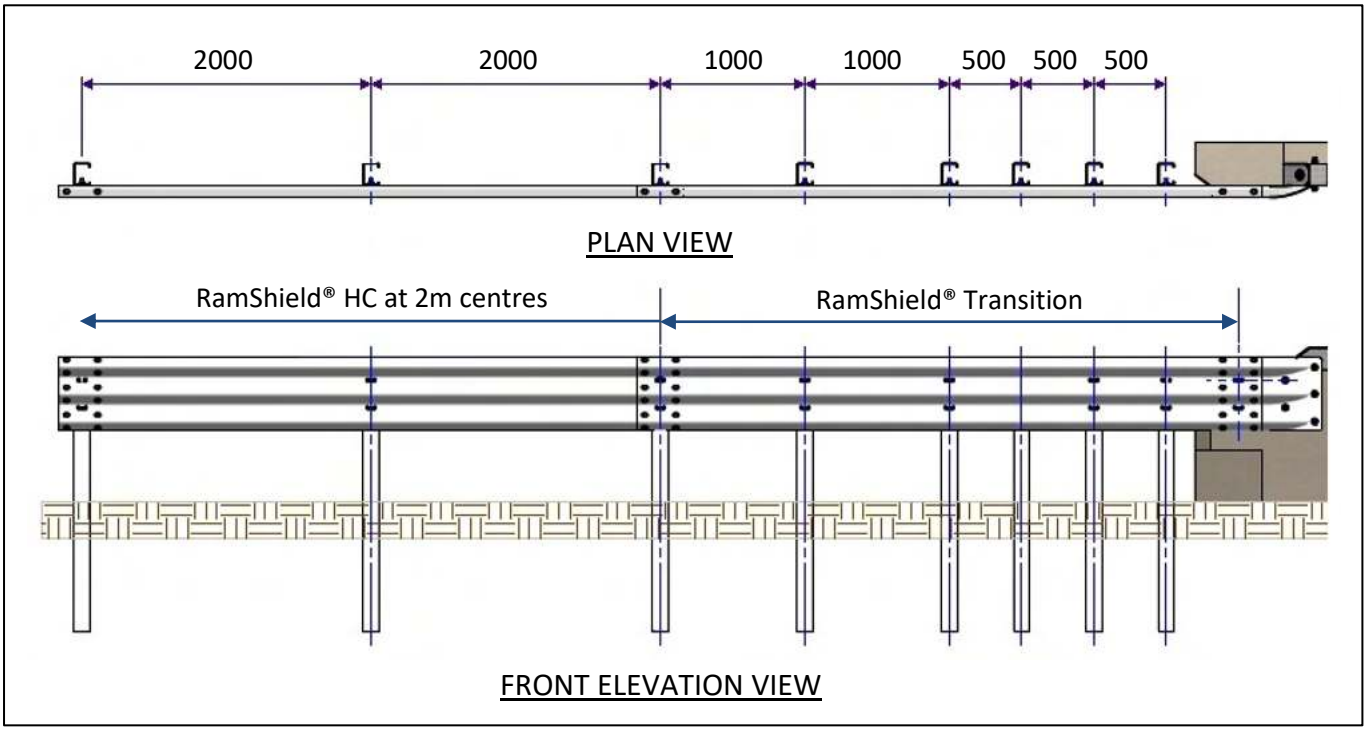


Figure 4: RamShield® Transition Connection to RamShield HC

6.9 End Terminals

End terminals are designed to anchor the safety barrier system and introduce the necessary tensile and flexural strength required for safe vehicle containment and re-direction throughout the length-of-need section. They also provide the additional feature of reducing the severity of an impact near or at the end of the system.

Guardrail end terminals are installed using w-beam guardrail, therefore it is necessary to transition from thrie-beam using an asymmetric transition before commencing installation of an end terminal. Thrie-beam cannot be used within the guardrail terminal section.

The MASH compliant SKT (MSKT) is an energy-absorbing tangential end terminal, designed to minimise the severity of impacts occurring at the end of the safety barrier system.

It is recommended that the RamShield® Transition be anchored with a MSKT terminal.

The MSKT terminal can connect directly to the w-beam end of the asymmetric transition.

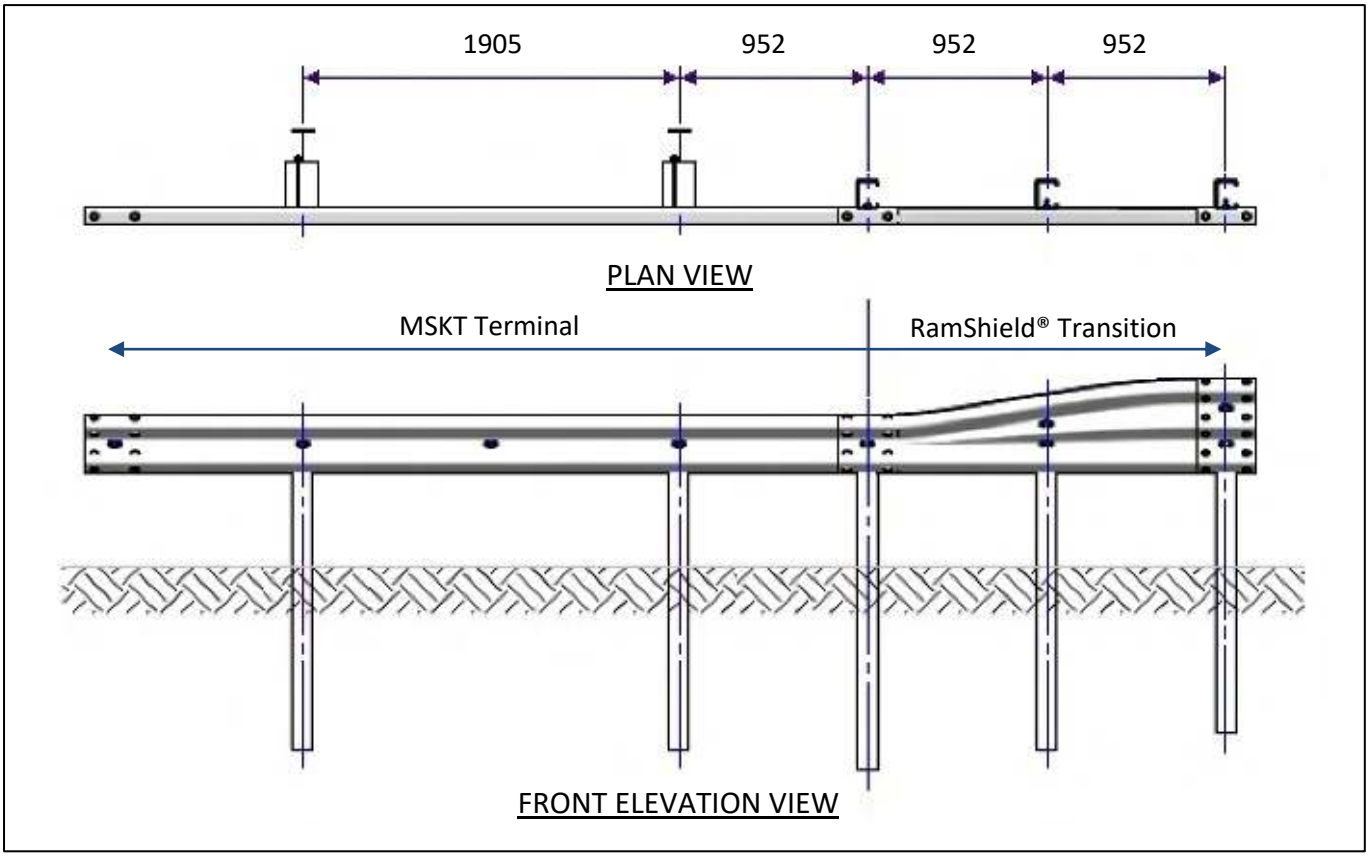


Figure 5: RamShield® Transition Connection to MSKT Terminal

6.10 Minimum Installation Length

It is recommended, where space permits, to install continuous safety barrier rather than designing a barrier to shield a specific hazard(s). A continuous safety barrier aims to protect the entire roadside and prevent vehicle rolling, impacts with hazards or head-on collisions.

When the installation of guardrail is required to shield the bridge abutment, the MSKT terminal can connect directly to the asymmetric transition as shown in Figure 5.

The minimum installation lengths, measured from the end terminal to the connection with the rigid barrier are detailed in Table 3.

Table 3: Minimum Installation Lengths

Design Speed	Leading Terminal	RamShield® Transition Length	Minimum Installation Length
≤ 70km/h (MASH TL2)	9.5m TL2 MSKT	5.9m	15.4m
> 70km/h (MASH TL3)	14.3m TL3 MSKT	5.9m	20.2m

6.11 Connection to a Concrete Parapet

The RamShield® Transition has been crash tested when attached to the same concrete parapet as the Austroads SBTA 21-005 Transition.

Since this parapet design is just 915mm high, a top mount bracket is required to position the thrie-beam terminal connector 1000mm above ground level.

Parapets taller than 1000mm will not require the top mount bracket.

The thrie-beam terminal connector is secured to the concrete parapet using mechanical anchors, eliminating the need for cast-in ferrules and associated alignment issues.

The use of mechanical anchors is also suited for retrofitting to existing parapets which are unlikely to contain ferrules.

7.0 RamShield® HC Component Identification

M16 x 32mm Bolt

M16 x 50mm Bolt

M16 Oversize Nut

M16 Standard Nut

1.9m Asymmetric Transitions
(32kg each)

Thrie-Beam Terminal Connector
(10kg each)

1860mm RamShield®
HC Post
(24 kg each)

4m Thrie-Beam Guardrail, 3.5mm
(93kg each)

8.0 Tools Required

Tools required for the installation of the RamShield® Transition are the same as those used for the installation of RamShield® HC. This includes:

- Post driving equipment or auger;
- Air compressor;
- Pneumatic drill driver with 32mm attachment;
- Metal snips;
- String line;
- Tape measure;
- Hammer;
- 12mm diameter pinch bar; and
- Slings or chains.

8.1 Recommended PPE

It is recommended that the following personal protective equipment (PPE) be provided for the safe installation of the RamShield® Transition:

- Safety footwear;
- Gloves;
- Hearing protection;
- High visibility clothing; and
- PPE as required for the use of post driving equipment or auger.

9.0 Site Establishment

9.1 Traffic Control

Prior to the commencement of any work, the site should be evaluated for risks to workers, pedestrians and other road users. The establishment of traffic control should provide safe travel for passing vehicles and/or pedestrians and appropriately protect workers near the roadside.

9.2 Underground Services

The installation of the RamShield® Transition requires the supporting posts to be embedded into the ground. Prior to the installation of posts an investigation for potential underground hazards is recommended.

9.3 Overhead Obstructions

The site should be evaluated for potential overhead obstructions that may present a risk during the installation process. These obstructions typically include power lines, signage or trees.

9.4 Unloading Exclusion Zone

Only appropriate load-rated slings or chains should be used for safe unloading. It is recommended that an exclusion zone be maintained around the unloading process. This provides distance between moving machinery and workers in the event that goods or the machinery move unexpectedly.

Unloading and the storing of the product on a level surface is recommended. Storing product adjacent to the installation area eliminates the requirement for workers to carry items over long distances.

10.0 RamShield® Transition Installation

The major steps in the installation of the RamShield® Transition are as follows;

- Set-out;
- Installing the C-posts;
- Attachment of the thrie-beam guardrail; and
- Installing the asymmetric transition (when connecting to w-beam).

10.1 Set-Out

It is recommended that a string line be used to establish the alignment of the post locations. When establishing the post locations, take care to note the following;

- The RamShield® Transition does not use offset blocks. The width of the system is just 235mm.
- The post spacing of the RamShield® Transition reduces to 500mm nearing connection to the concrete parapet or abutment post; and
- The nett laying length of the asymmetric transition is 1905mm.

10.2 Post Installation

Potential Hazards: *Use of post driving equipment or auger, contact with underground hazards, excessive noise, hand injury from pinch points and injury from movements and posture.*

Recommended Control Measures: *Observe the safe work instructions as per machinery requirements, ensure the area has been inspected for underground hazards, wear appropriate hearing protection, wear gloves and observe correct techniques when lifting (bend at the knees).*

The posts may be installed by;

- Driving with an appropriate driving head to the required depth, approximately 890mm, or
- Auguring a minimum 200mm diameter hole approximately 890mm deep, placing the post in the hole and backfilling. The backfill material is to be placed in 150mm lifts and compacted with tamping equipment.

Once installed, the top of the post should measure 970mm above ground level.

The spacing of the posts is shown in Figure 7.

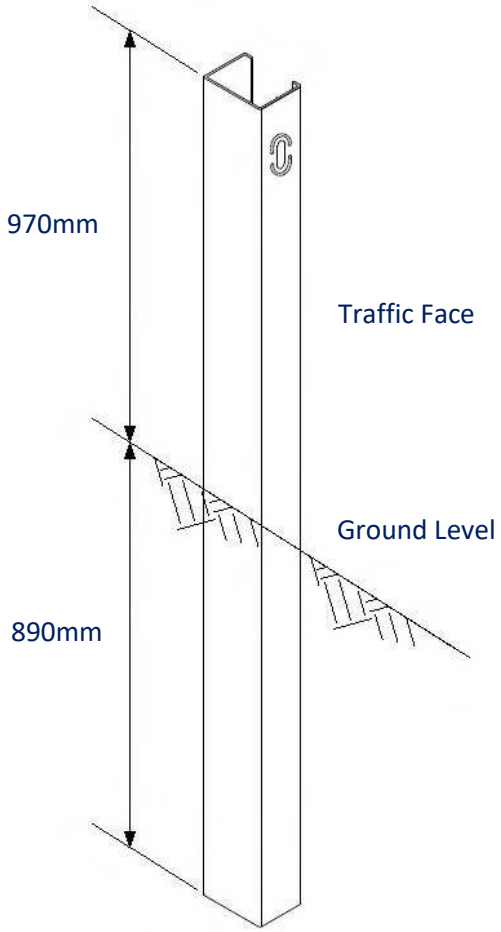


Figure 6: RamShield® Transition Post Installation

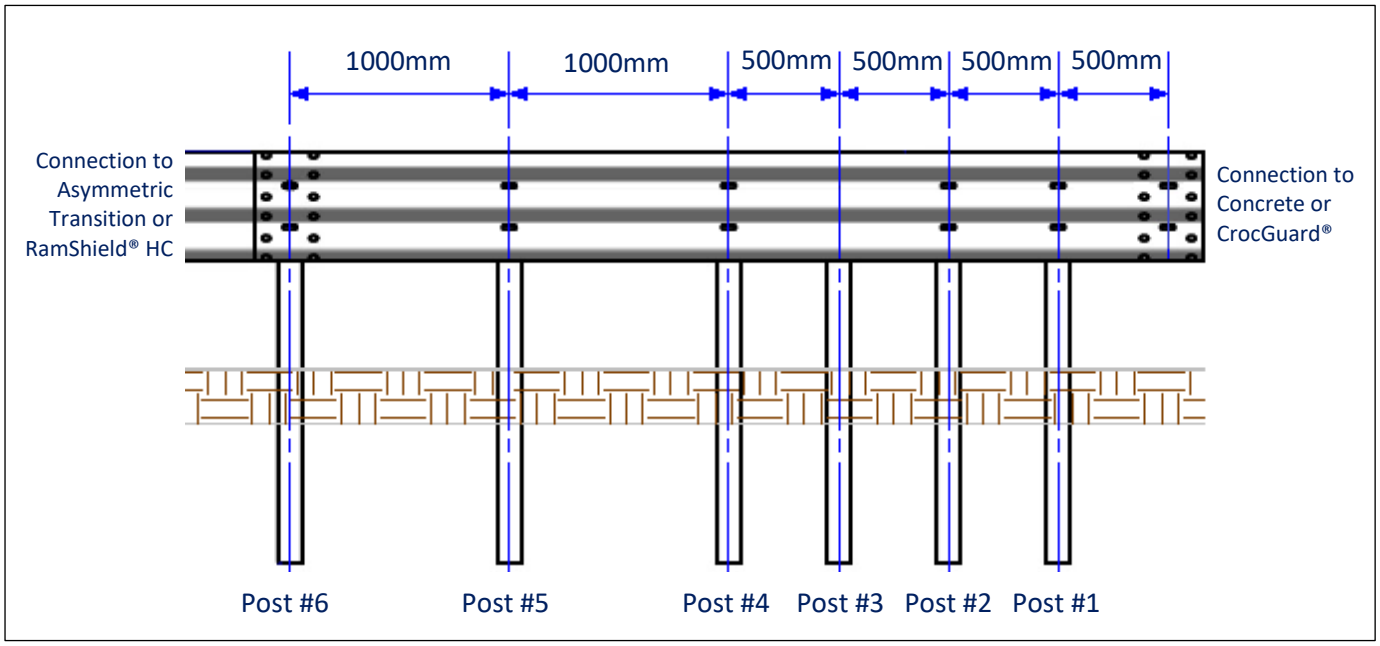


Figure 7: RamShield® Transition Post Spacing

10.3 Attaching the Thrie-Beam Rail

Potential Hazards: *Injury from movements and posture, hand injury from pinch points, strain to wrists from tightening bolts and excessive noise from use of impact driver.*

Recommended Control Measures: *Observe correct techniques when lifting rails (bend at the knees), wear gloves, use a pinch bar to align holes, use an impact drill to tighten bolts and wear appropriate hearing protection.*

A single 3.5mm thick, 4m thrie-beam guardrail is used within the RamShield® Transition system. The rail is secured to the posts using a M16 x 50mm mushroom head bolt and standard nut. The bolt passes through the upper slot in the thrie-beam rail. The nut is tightened using a 24mm attachment.

NOTE: The thrie-beam rail is NOT bolted at Post #2 and Post #3.

The thrie-beam lap with the downstream rail is orientated so that the leading edge of the splice is shielded from the nearside approaching traffic. The thrie-beam rail is spliced using twelve (12) standard M16 x 32mm mushroom head bolts and oversize nuts. The oversize nuts are tightened using a pneumatic drill driver and 32mm attachment.

The use of a pinch bar will assist in aligning the splice holes as the bolts are inserted. The use of a driving pin to elongate the splice holes is NOT permitted.

There is no torque requirement for the tightening of the post bolts or splice bolts. They should be tightened to a snug position.

Once secured to the posts, the finishing height of the thrie-beam will be 1000mm above ground level, approximately 30mm above the top of the posts.

10.4 Installing the Asymmetric Transition

Potential Hazards: *Injury from movements and posture, hand injury from pinch points, strain to wrists from tightening bolts and excessive noise from use of impact driver.*

Recommended Control Measures: *Observe correct techniques when lifting rails (bend at the knees), wear gloves, use a pinch bar to align holes, use an impact drill to tighten bolts and wear appropriate hearing protection.*

When connecting the RamShield® Transition to RamShield® W-Beam or a MSKT Terminal, the use of an asymmetric transition is required to transition from thrie-beam to w-beam. The asymmetric transition panel is 1905mm long (nett laying length) and is available as an approach or departure configuration as detailed in Figure 2.

1860mm RamShield® Transition posts are installed to support the asymmetric transition. Post spacing within the asymmetric transition is 952mm.

Since the asymmetric transition lowers top rail height by 200mm when connecting to w-beam guardrail, the embedment depth of the posts increases accordingly as shown in Figure 8.

The thrie-beam end of the asymmetric transition is connected to the 3.5mm thrie-beam with twelve (12) standard M16 x 32mm mushroom head bolts and oversize nuts. The oversize nuts are tightened using a pneumatic drill driver and 32mm attachment.

The w-beam end of the asymmetric transition is connected to w-beam with eight (8) standard M16 x 32mm mushroom head bolts and oversize nuts. The oversize nuts are tightened using a pneumatic drill driver and 32mm attachment.

The use of a pinch bar will assist in aligning the splice holes as the bolts are inserted. The use of a driving pin to elongate the splice holes is NOT permitted.

The asymmetric transition is secured to the posts using a M16 x 50mm mushroom head bolt and standard nut. The bolt passes through the upper slot in the rail. The nut is tightened using a 24mm attachment.

There is no torque requirement for the tightening of the post bolts or splice bolts. They should be tightened to a snug position.

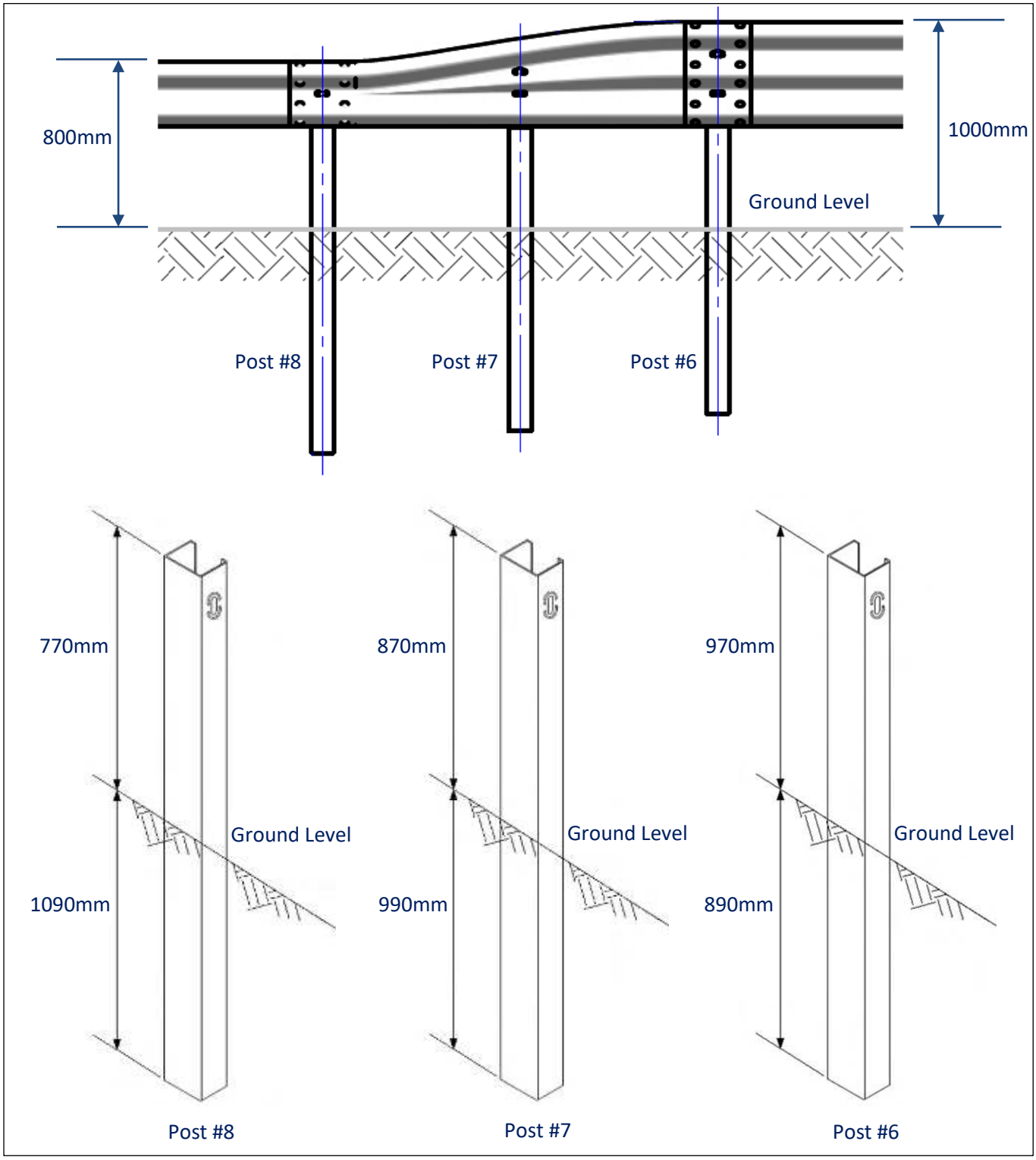


Figure 8: Installation of Asymmetric Transition Posts

10.5 Connection to CrocGuard®

Potential Hazards: *Injury from movements and posture, hand injury from pinch points, strain to wrists from tightening bolts and excessive noise from use of impact driver.*

Recommended Control Measures: *Observe correct techniques when lifting rails (bend at the knees), wear gloves, use a pinch bar to align holes, use an impact drill to tighten bolts and wear appropriate hearing protection.*

CrocGuard® is a composite barrier system comprising external thrie-beam rails that encases a concrete core. CrocGuard® features a conventional thrie-beam splice and is connected to the 3.5mm thrie-beam panel of the RamShield® Transition with twelve (12) standard M16 x 32mm mushroom head bolts and oversize nuts. The oversize nuts are tightened using a pneumatic drill driver and 32mm attachment.

The use of a pinch bar will assist in aligning the splice holes as the bolts are inserted. The use of a driving pin to elongate the splice holes is NOT permitted.

There is no torque requirement for the tightening of the post bolts or splice bolts. They should be tightened to a snug position.

The installed height of CrocGuard® is 1000mm, the same height as the RamShield® Transition.

Figure 9: CrocGuard® Abutment Post

Figure 10: Connection to CrocGuard® (Departure View)

Figure 11: Connection to CrocGuard® (Approach View)

Figure 12: Thrie-Beam Connection to Transition Posts

10.6 Connection to Concrete

Potential Hazards: *Injury from movements and posture, hand injury from pinch points, strain to wrists from tightening bolts and excessive noise from use of impact driver.*

Recommended Control Measures: *Observe correct techniques when lifting rails (bend at the knees), wear gloves, use a pinch bar to align holes, use an impact drill to tighten bolts and wear appropriate hearing protection.*

When connecting to concrete, a thrie-beam terminal connector is spliced to the 3.5mm thrie-beam panel of the RamShield® Transition with twelve (12) standard M16 x 32mm mushroom head bolts and oversize nuts. The oversize nuts are tightened using a pneumatic drill driver and 32mm attachment.

The lap is orientated so that the leading edge of the splice is shielded from the nearside approaching traffic.

The terminal connector is connected to concrete using M20x187mm Fisher FBN II anchors. Using the terminal connector as a template, drill a M20 hole to a depth of 140mm for each anchor.

Blow the dust from each hole using a blowout pump or compressed air, ensuring that each hole is free from loose materials.

Position the nut of the anchor close to the tip, protecting the thread from accidental damage and drive the anchor bolt into each hole by hammering.

Position the terminal connector and torque each M20 anchor to 200Nm

Where the parapet has been constructed in accordance with the Austroads SBTA 21-005 Transition or the existing parapet is less than 1m high, a top mount bracket is required to facilitate connection of the upper anchor bolt of the terminal connector.

The top mount bracket (supplied by Safe Direction) is secured to the top of the concrete parapet with two (2) M16x145mm Fisher FBN II anchors.

Drill a M16 hole to a depth of 100mm for each anchor. Blow the dust from the hole using a blowout pump or compressed air ensuring that the hole is free from loose materials.

Position the nut of the anchor close to the tip, protecting the thread from accidental damage and drive the anchor bolts into the holes by hammering.

Position the top mount bracket and torque each M16 anchor to 100Nm.

Connect the upper hole of the thrie-beam terminal connector to the top mount bracket with a M20x200mm structural bolt/nut & washer.

Figure 11: Thrie-Beam Terminal Connection to Top Mount Bracket

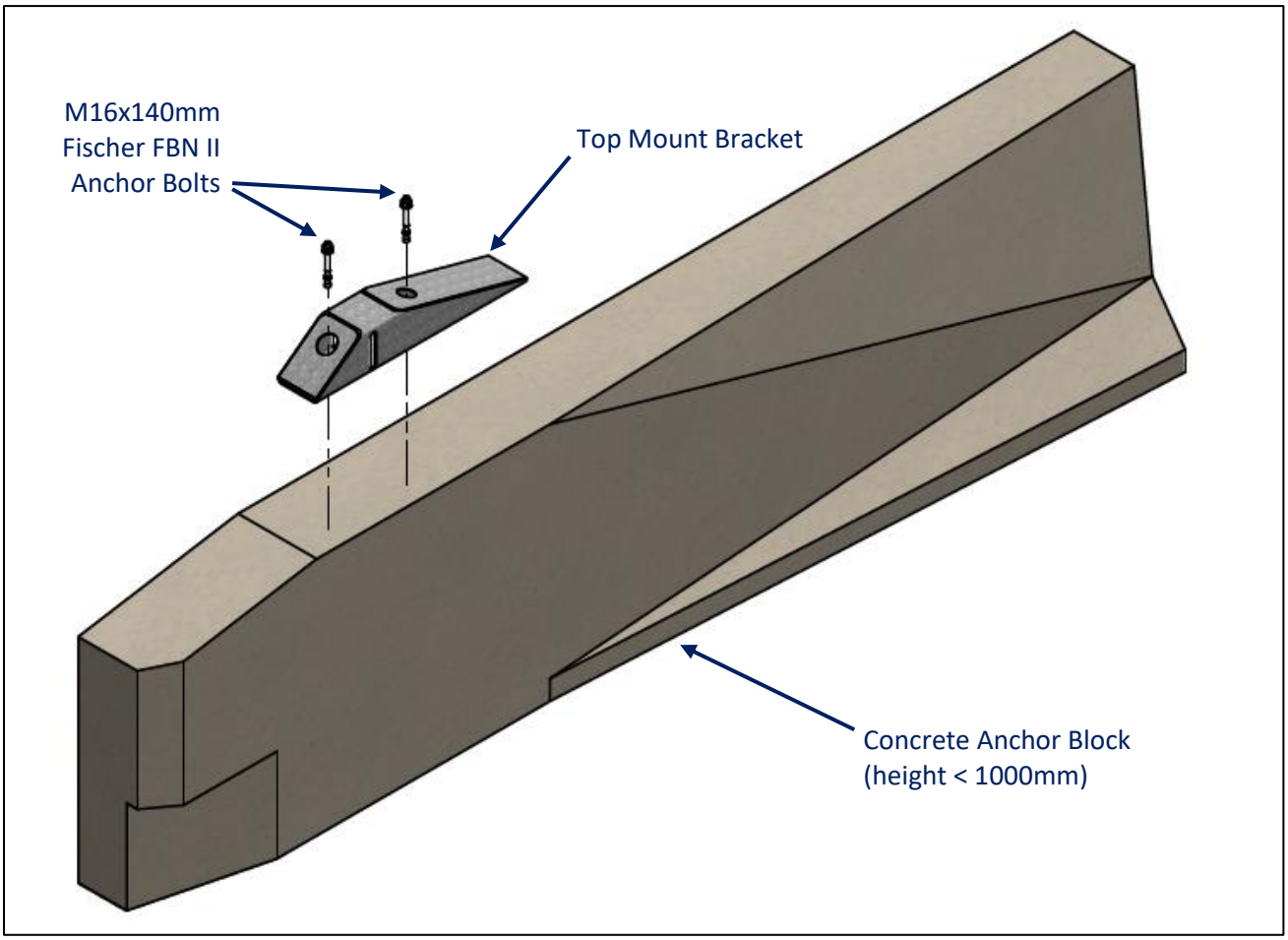


Figure 12: Top Mount Bracket Connection

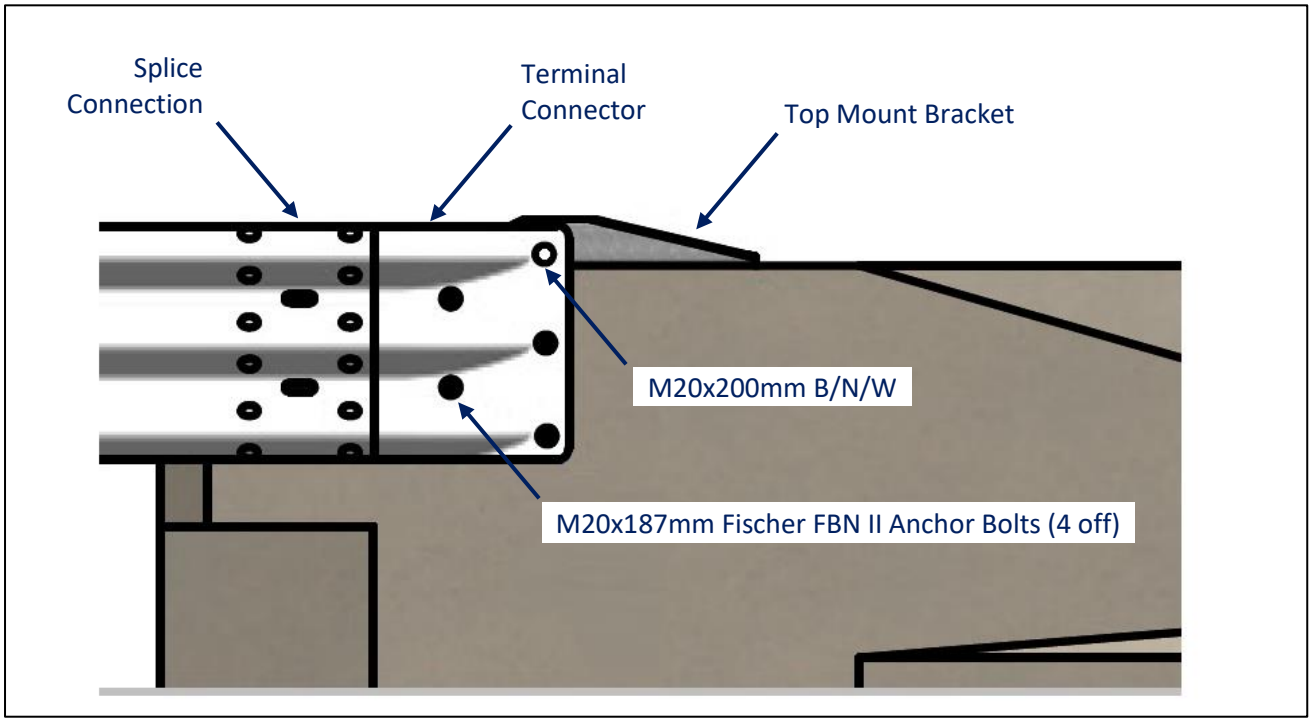


Figure 13: Terminal Connector Connection

11.0 Installation Tolerances

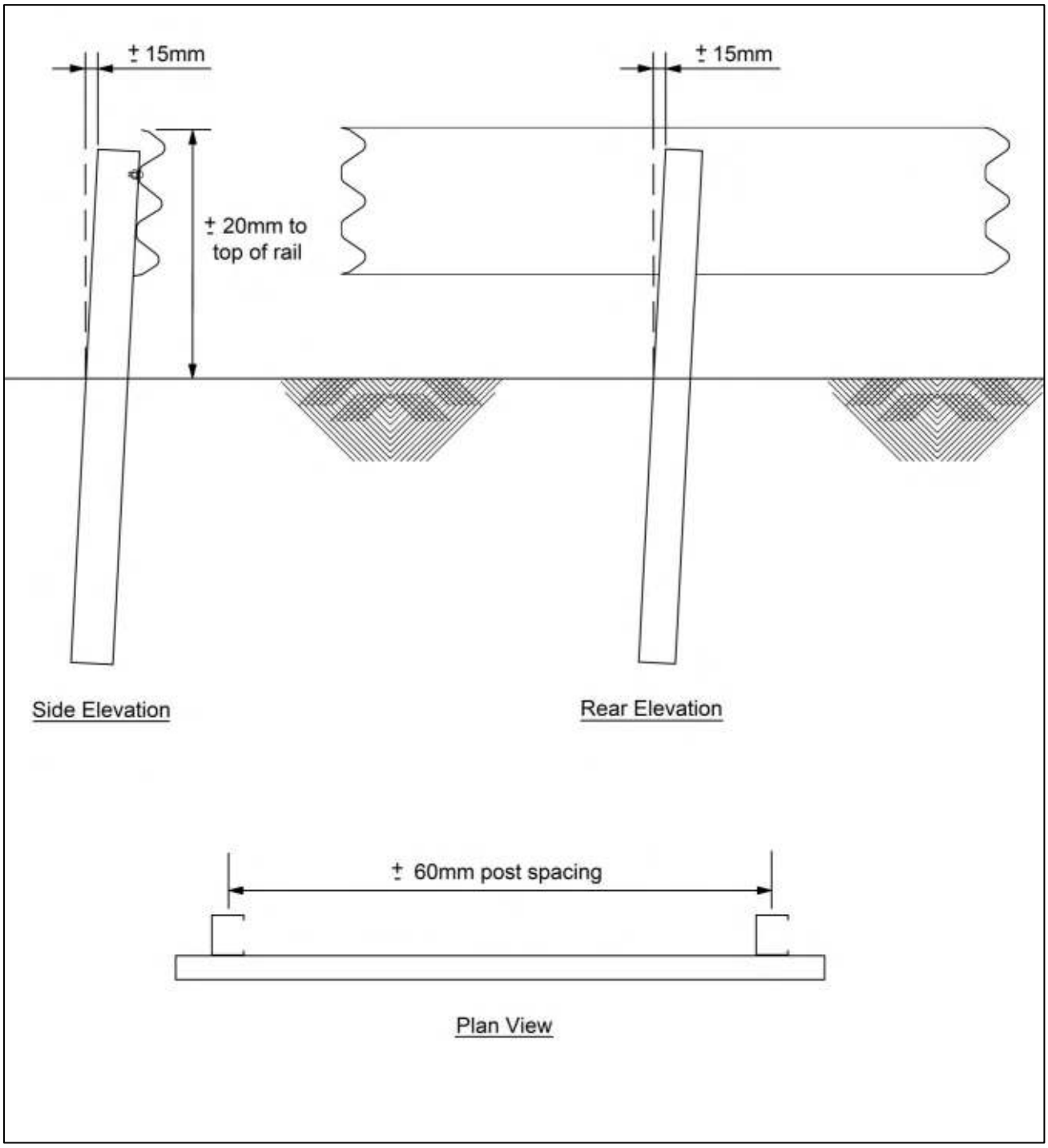


Figure 16: RamShield® Transition Installation Tolerances

RamShield® Transition Inspection Form

Inspection Date	
Client	
Project Reference	
Name of Inspector	
Company	

❑ Yes ❑ No	The 4m thrie-beam rail is 3.5mm thick.
❑ Yes ❑ No	The spacing of posts complies with Safe Direction assembly drawings.
❑ Yes ❑ No	The thrie-beam rail is bolted to Posts #1, #4, #5 & #6 with one (1) M16 x 50mm mushroom head bolt & standard nut.
❑ Yes ❑ No	The thrie-beam rail is NOT bolted to Posts #2 & #3.
❑ Yes ❑ No ❑ n/a	Asymmetric transitions are used when connecting to RamShield W-Beam guardrail.
❑ Yes ❑ No ❑ n/a	When connecting to RamShield W-Beam guardrail, the 4m in advance of the asymmetric transition has posts installed at 1m centres.
❑ Yes ❑ No	The posts are correctly orientated with the release tab on the traffic side.
❑ Yes ❑ No	The height measured to the top of the thrie-beam rail is 1000mm ± 20mm.
❑ Yes ❑ No	The thrie-beam rail is spliced with twelve (12) M16 x 32mm mushroom head bolt & oversized nuts.
❑ Yes ❑ No	The rail lap is orientated so that the leading edge of the splice is shielded from approaching traffic.
❑ Yes ❑ No	All post bolts and splice bolts are tightened.
❑ Yes ❑ No ❑ n/a	When connecting to a concrete parapet, the terminal connector is secured with M20x187mm FBN II anchors.
❑ Yes ❑ No ❑ n/a	If the concrete parapet is less than 1m high, a top mount bracket is secured with two (2) M16x140mm FBN II anchors to facilitate attachment of the terminal connector at 1m high.
❑ Yes ❑ No ❑ n/a	The FBN II anchors are correctly torqued.
❑ Yes ❑ No	The fill material around the posts is suitably compacted.
❑ Yes ❑ No	Any minor damage to the galvanised finish is repaired using two coats of an organic zinc rich paint.
❑ Yes ❑ No	The area around the barrier is free of debris.
Comments/Notes	

12.0 Maintenance

The RamShield® Transition is a low maintenance barrier. Except for repairs due to impacts, it is recommended that an annual inspection be undertaken to assess the following;

- Debris has not accumulated around the barrier which may impede the function of the barrier;
- Vegetation around the barrier is appropriately maintained;
- Nuisance impacts have not gone undetected; and
- The anchor assembly at the end terminals is taut and the bearing plate is correctly aligned.

13.0 Repair

In the event of a vehicle impact, damage to the barrier is to be assessed in accordance with Table 4. Typically, impacts with the RamShield® Transition will require replacement of damaged sections of rails and posts. It is also recommended that new bolts be used where rails and posts have been replaced.

Additional tools required for repair include;

- Acetylene torch to cut away damaged rail;
- Heavy duty chain to remove damaged posts;
- Sledge hammer; and
- Post extractor.

Similar to the installation sequence, it is recommended that the guidelines contained in Section 9.0 be observed in the establishment of traffic control and an unloading exclusion zone in addition to investigation for underground services and overhead obstructions.

13.1 Removal of Damaged Posts

Potential Hazards: *Hand injury from pinch points, hand injury from damaged edges and injury from sudden movement as the posts are released.*

Recommended Control Measures: *Wear gloves and maintain an appropriate exclusion zone around the post until removed.*

Damaged posts should be removed using an appropriate post extractor. Once the damaged post is removed, the ground material should be suitably compacted before a replacement post is installed.

13.2 Removal of Damaged Rails

Potential Hazards: *hand injury from pinch points, hand injury from damaged edges, injury from sudden movement as rails are released and excessive noise from use of impact drill.*

Recommended Control Measures: *Wear gloves and wear appropriate hearing protection.*

Using an impact drill, remove the splice bolts at the rail connection. Rails that have twisted or bent during impact may need to be cut into manageable sections using an acetylene torch.

Table 4: Damage Assessment Guidelines

Type of Damage	Description of the Damage	Remedial Action
Damage to the galvanised coating on the posts.	The sum total of the damaged area does not exceed 70cm^2 (0.5% of the total surface area) and no individual damaged area exceeds 40cm^2.	An organic zinc rich paint is to be applied to the repair area in two coats.
	The sum total of the damaged area exceeds 70cm^2 (0.5% of the total surface area) or an individual damaged area exceeds 40cm2.	The post is to be replaced.
Damage to the galvanised coating on the rails.	The sum total of the damaged area does not exceed 250cm^2 and no individual damaged area exceeds 40cm^2.	An organic zinc rich paint is to be applied to the repair area in two coats.
	The sum total of the damaged area exceeds 250cm^2 or an individual damaged area exceeds 40cm^2.	The rail is to be replaced.
Damage to the posts.	The post is bent.	The post is to be replaced.
Damage to the post tab.	The post tab has distorted and released the post bolt.	The post is to be replaced.
Damage to the rails.	The rail is dented, twisted or flattened.	The rail is to be replaced.
	There are nicks in any part of the rail.	
	The slots in the rail are distorted.	
Damage to bolts.	The body of the bolt is distorted.	The bolt is to be replaced.
	The thread of the bolt is damaged.	
Disturbance of material around the posts.	The material around a post is loose.	The material is to be suitably compacted.

SafeDirection

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