RamShield®
High Containment
MASH TL4 Thrie-Beam Guardrail



MASH TL3 Compliant

MASH TL4 Compliant

ramshield.com

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Version	Date	Revisions
04	February 2026	Updated format

Leading Safety

Successfully crash tested to MASH Test Level 3 & 4

Approved by the Austroads Safety Barrier Assessment Panel (ASBAP)

Complies with AS/NZS 3845.1:2015 Road Safety Barrier Systems and Devices

Superior Design

Simple rail to post assembly

Just 235 mm system width

Same C-post profile as used in public domain systems

Reduced post embedment depth when compared with public domain systems

Low Deflection

Shields roadside hazards close to the travelled way

Stable vehicle containment and redirection

Reduced distance between the barrier and a fixed hazard

Compatibility

Features standard thrie-beam manufactured by Safe Direction

Compatible with all RamShield® guardrail variants and Safe Direction guardrail end terminals

Standard 2 m post spacing

Fast Assembly

Fewer parts

Stiff driving C-post

Local

Designed in Australia by Safe Direction

1.0 Introduction

RamShield® High Containment (HC) is the latest innovation and advancement in thrie-beam guardrail barrier designs. Developed by Safe Direction, RamShield® HC has been full-scale crash tested to MASH Test Level 3 & Test Level 4.

Thrie-beam guardrail is a stronger version of w-beam guardrail systems. The additional corrugation in the rail combined with the higher mounting height, stiffens the barrier and improves its ability to contain larger vehicles.

RamShield® HC has advanced the containment level of public domain thrie-beam guardrail by introducing patented technology into the thrie-beam guardrail release mechanism. This results in a safer barrier design with fewer components allowing more metres of barrier to be deployed per public dollar to protect Australian motorists.

2.0 Specifications

Crash Test Compliance	MASH Test Level 3 and MASH Test Level 4
MASH TL3 Dynamic Deflection	1.0 m
MASH TL3 Working Width	1.1 m
MASH TL4 Dynamic Deflection	1.1 m
MASH TL4 Working Width	2.2 m
System Width	235 mm
System Height	1000 mm, measured to top of thrie-beam
System Mass (without blocking pieces)	30 kg per metre
Standard Post Length	1860 mm
Standard Post Embedment Depth	890 mm
Standard Post Spacing	2.0 m centres
Post Mass	23.9 kg
System Finish	Hot dip galvanised in accordance with AS/NZS 4680

3.0 How RamShield® High Containment Works

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

RamShield® HC uses standard thrie-beam guardrail and standard fasteners meaning there is minimal risk of inadvertent use of non-compliant items.

Upon release of the thrie-beam rail, the C-posts collapse upon impact yielding proximate to the ground surface. This release and collapse mechanism makes RamShield® HC suitable for use in stiff soils and deep asphalt applications.

The sectional strength of the C-post limits barrier deflection, an important design consideration when shielding roadside hazards.

The working mechanism of RamShield® HC is a patented concept designed and developed by Safe Direction. The concept is the latest innovation in thrie-beam guardrail designs and sets a new benchmark in simplicity and performance.



4.0 Crash Test Performance

RamShield® HC has been crash tested and evaluated according to the specifications for Test Level 3 (TL3) and Test Level 4 (TL4) 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.

RamShield® HC has been assessed as a longitudinal barrier, designed to contain, redirect, and shield vehicles from roadside obstacles. Vehicle impacts in accordance with MASH TL3 and TL4 are performed as follows:

- 1100 kg passenger car travelling at 100 km/h and 25 degrees (75.8 kJ).
- 2270 kg pick-up truck travelling at 100km/h and 25 degrees (156.4 kJ).
- 10,000 kg rigid truck travelling at 90 km/h and 15 degrees (209.3 kJ).



Table 1: RamShield® High Containment Crash Test Results.

MASH TL3 Dynamic Deflection 2270 kg pickup truck, 100 km/h, 25 degrees	1.0 m
MASH TL4 Dynamic Deflection 10,000 kg rigid truck, 90 km/h, 15 degrees	1.1 m

5.0 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® HC 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 2.7 mm



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

6.0 Design Considerations

6.1 Barrier Deflection

Dynamic deflection is the maximum lateral displacement of the barrier during a vehicle impact. When a vehicle strikes a barrier, the dynamic deflection varies according to the characteristics of the impacting vehicle, including vehicle mass, impact speed, angle of impact and the characteristics of the barrier system.

Where the hazard is low enough that it does not interfere with the possible vehicle intrusion into the area behind a barrier, for example a batter slope, dynamic deflection is considered the most appropriate design consideration.

The MASH TL3 and MASH TL4 impact conditions have been developed to represent 'worst case impact scenario'. Please consult with Safe Direction for calculated RamShield® HC deflections at varying vehicle speeds and impact angles.

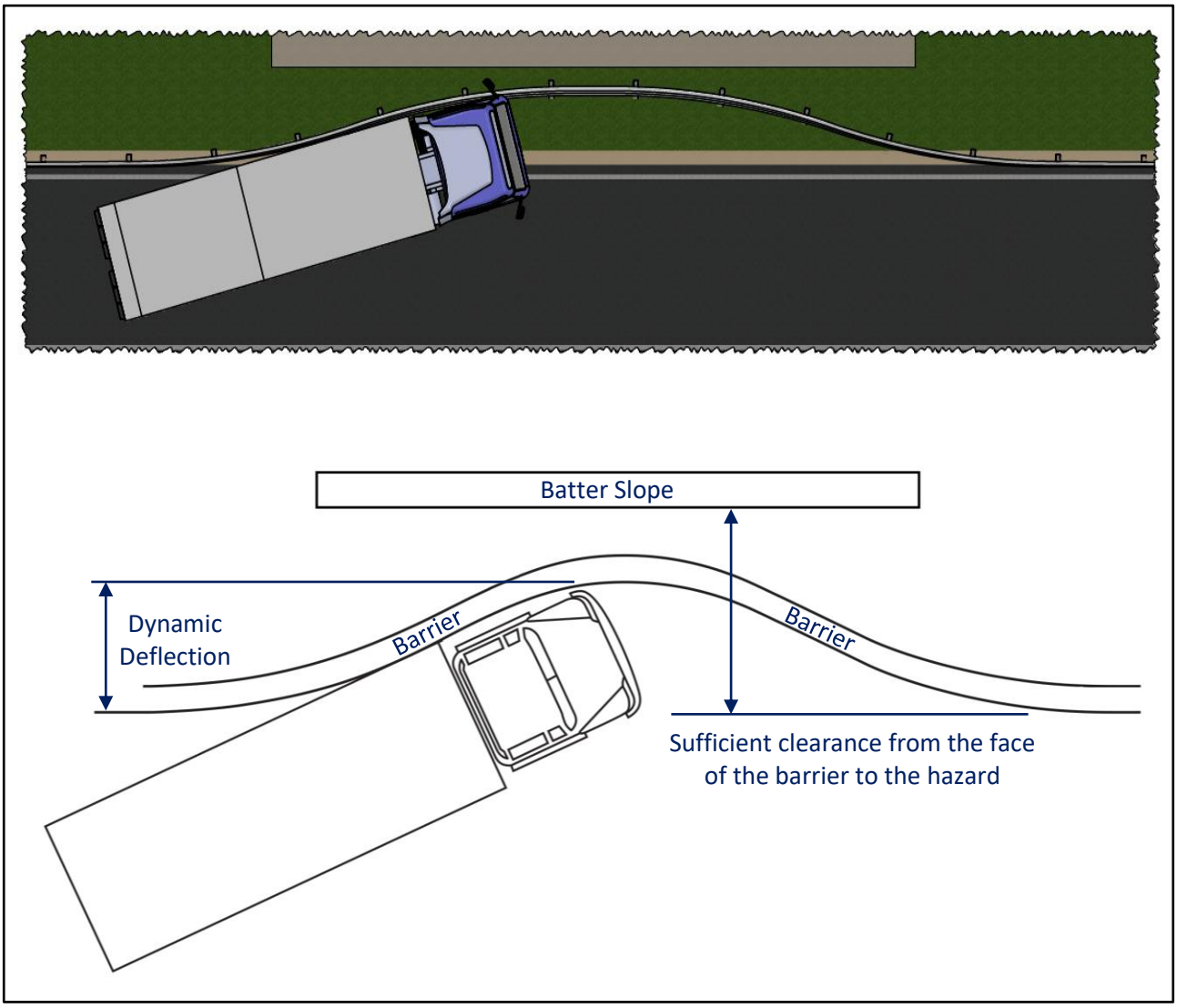


Figure 1: Dynamic Deflection.

6.2 Working Width

The working width is the minimum distance required to prevent an impacting design vehicle from colliding with an object behind a barrier system. This includes both the dynamic deflection of the barrier and the extra width to allow for the roll (vertical rotation) of an impacting vehicle.

Working width is an important design consideration when shielding above-ground fixed hazards such as trees, sign supports or bridge piers.

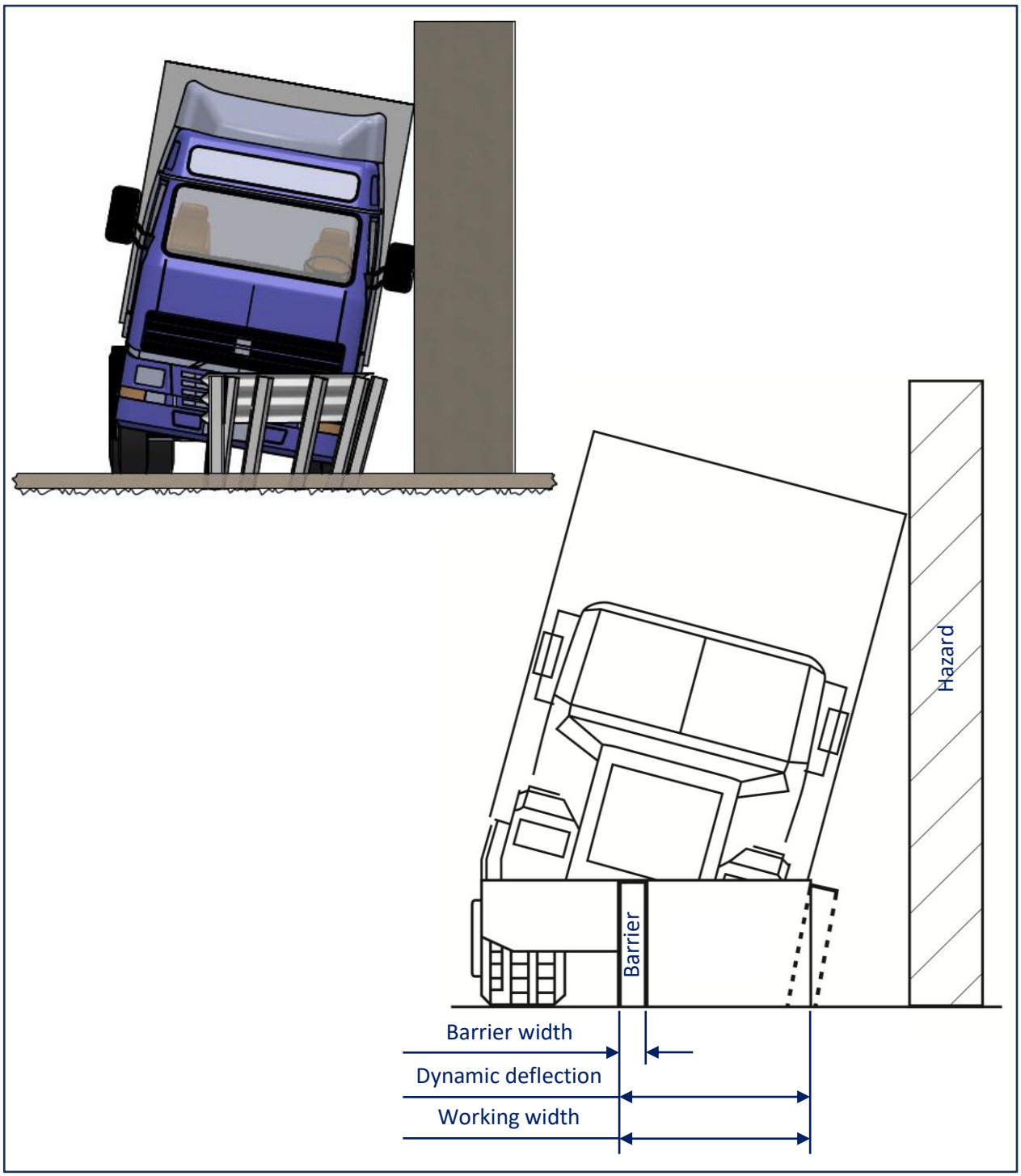


Figure 2: Working Width.

6.3 Offset from the Traffic Lane

Road safety barriers should be located (e.g. offset, lateral position) as far as possible from the edge of the traffic lane as site conditions permit but within the limits described below. This enables errant drivers to recover and regain control of the vehicle, minimising the frequency of barrier impacts. Wider offsets can reduce nuisance impacts on the barrier and enable disabled vehicles to be free of the traffic lanes on a high-speed road, therefore reducing the risk of secondary crashes.

Providing a consistent barrier offset is especially important for long lengths of continuous barrier. Consistent barrier design creates a uniform view, while frequent changes in barrier offset can mislead drivers and negatively impact decisions while driving, especially in adverse visibility conditions.

The offset is measured from the edge of the traffic lane to the face of the thrie beam barrier.

The offset needs to ensure that the available stopping sight distance and intersection sight distance are not impeded. Increased offsets allow vehicles to stand clear of the adjacent traffic lane after an impact if the vehicle is disabled and for maintenance activities. The practicality and costs of maintenance of a barrier and the areas on both sides of the barrier should be considered along with Occupational Health & Safety implications.

The recommended offsets to barriers are detailed in Table 2. It is recommended that barriers must not be closer than 0.5 m from traffic lanes on rural roads to minimise nuisance hits. Similarly, the minimum offset on urban roads is 0.3 m.

Table 2: Recommended Offset Distances. Source: Table 6.5 Austroads Guide to Road Design Part 6.

	Rural High Speed [1, 3]	Rural Low Speed	Urban Freeways [3]	Urban Roads [2]
Desirable	4.0 – 6.0 m	3.0 – 6.0 m	4.0 – 6.0 m	2.5 – 3.0 m
Minimum	3.0 m	2.5 m	3.0 m	1.0 m

Notes:

1. *Operating speed greater than or equal to 80 km/h.*
2. *The offset may be governed by the required offset to kerbs.*
3. *Adoption of widths less than 3 m shall include assessment of desired operating practices, including emergency response, maintenance and police enforcement.*

6.4 Flaring

Generally, there should be uniform clearance between traffic and roadside features, particularly in urban areas where there are many 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 and barriers.

6.5 Advance Grading

It is recommended that the area in advance of RamShield® HC 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.

6.6 Adjacent to Batter Slopes

Space in the road corridor is premium. In an effort to maximise space for other infrastructure and landscaping, the proximity of the guardrail post to the batter hinge point is often reduced 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.

State Road Agency guidelines typically require the distance from the hinge point be sufficient to accommodate the barrier's design deflection and provide adequate lateral support for the system.

Positioning the barrier closer to the hinge point:

- Increases the risk of the barrier failing if its lateral support is insufficient.
- Reduces the ease for the maintenance crews to inspect and reconstruct the barrier.
- Increases the risk that the vehicle will become unstable on the shoulder, or has a more unstable redirection; and
- Increases the possibility that the embankment slope will be damaged on impact and will be more difficult to repair.

However, moving the barrier closer to the road:

- Increases the potential for high-frequency impacts with the barrier.
- Reduces road shoulder width; and
- Increases centreline crowding and risk of head-on collision.

Therefore, at constrained sites, the barrier may be required to be positioned closer to the batter hinge point. At these locations, industry practice has been to install longer posts providing increased embedment depth and improved barrier lateral support.

Safe Direction has undertaken dynamic load impacts on the RamShield® HC post when installed adjacent to a weak soil embankment, studying the effects of increasing post embedment depth and comparing post yielding behaviour with flat terrain performance.

RamShield® Edge provides an engineered solution for post installation on the hinge point of a steep, weak soil embankment. Please refer to Section 9.0.

6.7 Minimum Installation Length

It is recommended, where space permits, to install continuous safety barrier rather than designing a barrier to shield a specific hazard. A continuous safety barrier aims to protect the entire roadside and prevent head-on collisions.

At constrained sites where continuous barrier is not achievable, a shorter length barrier may be installed. The recorded vehicle contact lengths with the barrier during MASH TL3 and MASH TL4 crash testing were 12 m and 20 m respectively.

6.8 Placement in Rock or Asphaltic Concrete

The rail release mechanism and performance of RamShield® HC differs from traditional barrier designs. Traditional posts will absorb some crash energy through post rotation in the surrounding soil prior to fully yielding. Setting these posts in deep lift asphalt or rock may compromise the performance of the system.

The patented RamShield® HC tab regulates the forces required to release the thrie-beam rail during a vehicle collision. The RamShield® HC posts will typically yield by bending proximate to ground level. Restraining the RamShield® HC posts below ground level does not adversely affect the rail release mechanism.

Therefore, acceptable foundation pavement conditions for the installation of the RamShield® HC posts includes the following:

- Narrow holes drilled into rock.
- Deep lift asphaltic concrete.
- Asphaltic concrete over granular pavement.
- Flush seal over granular pavement.
- Unsealed compacted formation.

Please consult with Safe Direction when rock is encountered, and full post embedment depth cannot be achieved.

6.9 Installation on Curves

In the field, straight sections of thrie-beam can be used to form a horizontal radius of 45 m or greater. When a radius of less than 45 m is required, the w-beam rails are required to be factory curved.

There are no limitations regarding crest or sag vertical curves for the assembly of thrie-beam guardrail. Designers should refer to state road agency specifications for vertical alignment design guidelines. The minimum radius for crest vertical curvature is usually governed by sight distance requirements. Sag curves are generally designed as large as economically possible using the comfort criterion as a minimum.

6.10 Reduced Post Spacing

At constrained sites the available clearance between the barrier and hazard may be limited and insufficient to accommodate the barrier deflection at the standard 2.0 m post spacing.

The post spacing of RamShield® HC may be reduced to 1.0 m, reducing the dynamic deflection to 0.6 m for both MASH TL3 and MASH TL4 impacts.

It is recommended that the reduction in post spacing commence 10 m upstream of the hazard requiring shielding. If the roadway is undivided, the reduction in post spacing should also extend 10 m downstream of the hazard.

Note: Safe Direction thrie-beam guardrail is pre-punched at 1.0 m centres, eliminating the requirement for onsite drilling to accommodate the reduced post spacing.

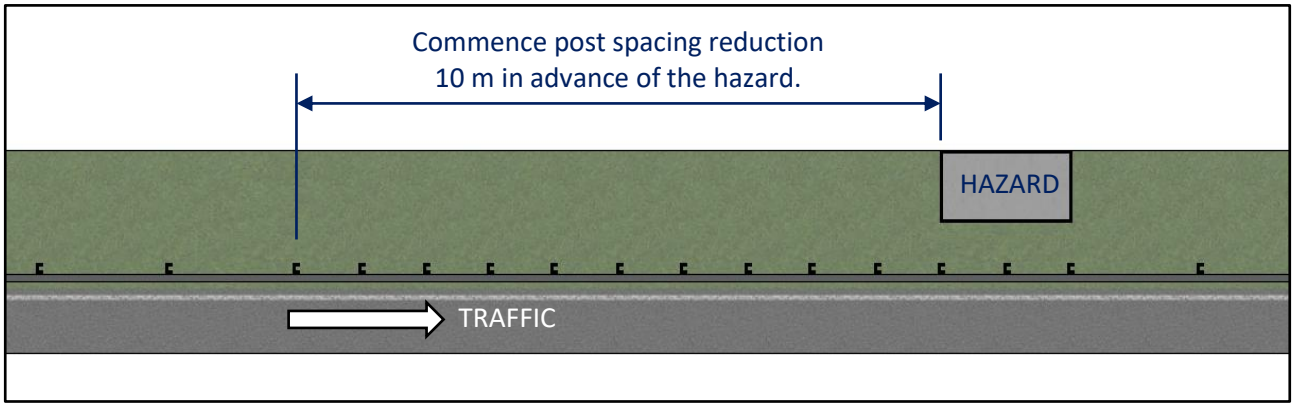


Figure 3: RamShield® High Containment, Reduced Post Spacing.



6.11 The Point-of-Need

The point-of-need (PON) is the location along the barrier system where containment and redirection of an errant vehicle commences. The distance between the leading and trailing points of need is referred to as the length of need.

The MASH TL3 point-of-need provides containment of a 2270 kg pick-up truck travelling at 100 km/h and 25 degrees. The MASH TL3 point-of-need is typically dependent upon the end terminal selected to anchor the system. For example, the point-of-need of the MASH TL3 MSKT terminal is post location 3, a distance of 3.81 m downstream from the start of the terminal.

The MASH TL4 point-of-need provides containment of a 10,000 kg rigid truck travelling at 90 km/h and 15 degrees. The MASH TL4 leading point-of-need for RamShield® HC is 9.5 m downstream of the asymmetric transition as shown in Figure 4.

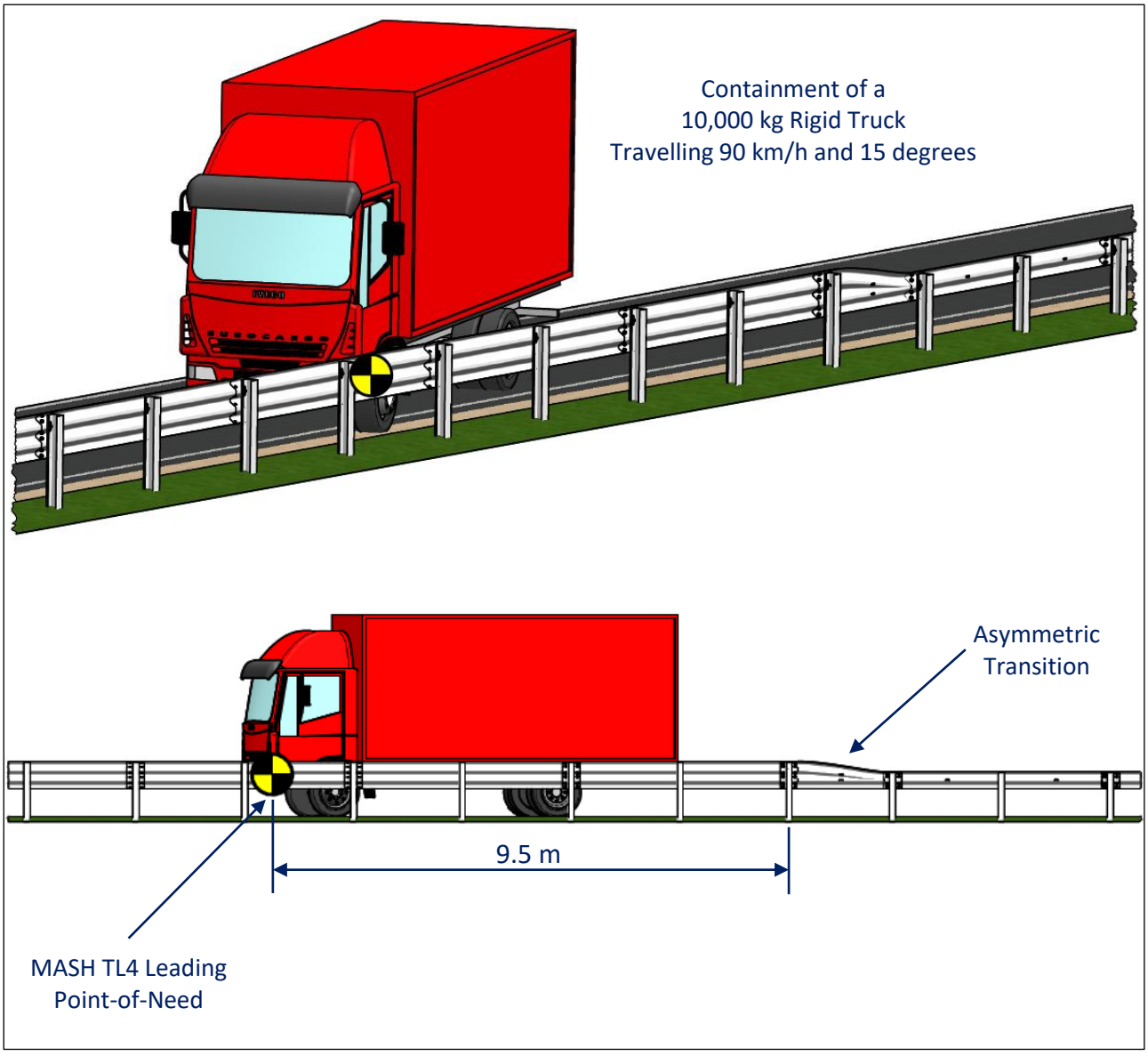


Figure 4: RamShield® HC, MASH TL4 Point of Need.

6.12 Posts with Baseplates

Underground services and/or structures such as culverts may prevent RamShield® HC from being installed with posts driven into the ground. In these circumstances RamShield® HC may be installed with posts on baseplates secured to a concrete strip footing.

The RamShield® HC concrete footing was modelled with no soil behind the beam and therefore relies upon the beam mass to resist movement and overturning forces. This concept provides an important differentiation from footing designs that rely upon soil resistance since onsite soil properties are often unknown.

In addition, the RamShield® HC concrete footing has been assessed with posts positioned at the front and rear of the beam. This methodology assesses the maximum applied overturning moment, shear load and uplift force acting on the concrete beam and provides designers with a working tolerance range for the positioning of the posts.

The safe vehicle containment of the simulated impacts demonstrates appropriate footing and beam mass. Safe Direction provides various footing size options providing equivalent beam mass as adopted for the simulation impacts. In addition, mechanical or chemical anchor options are provided. Please refer to Safe Direction drawings. Anchor options for the attachment of the baseplate include:

- Four (4) M20 x 187 mm galvanised Fischer FBN II anchors. Minimum embedment depth of 125 mm with each anchor torqued to 200 Nm, or

- Four (4) M20 galvanised threaded rods, class 8.8. Minimum embedment depth of 170 mm with each anchor secured with Fischer SB 390 and torqued to 120 Nm.

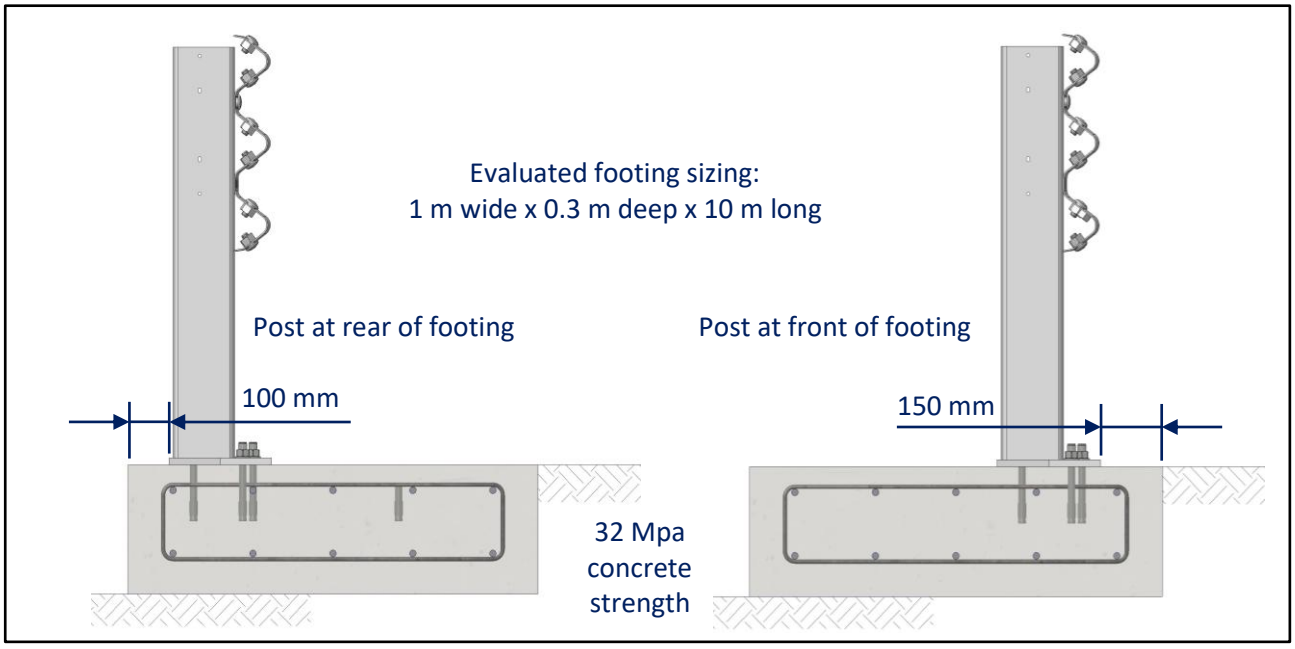


Figure 5: Assessment of RamShield® HC Posts with Baseplates.

To further assist designers in circumstances when the post on baseplate will be secured to an existing footing or structure, Safe Direction has undertaken RamShield® HC post capacity analysis using LS-Dyna.

Table 3: RamShield® HC with Posts on Baseplates, Strip Footing Sizing Options.

Depth (mm)	Width (mm)	Minimum Length (m)
250	1200	10
300	1000	10
400	800	12
500	600	17

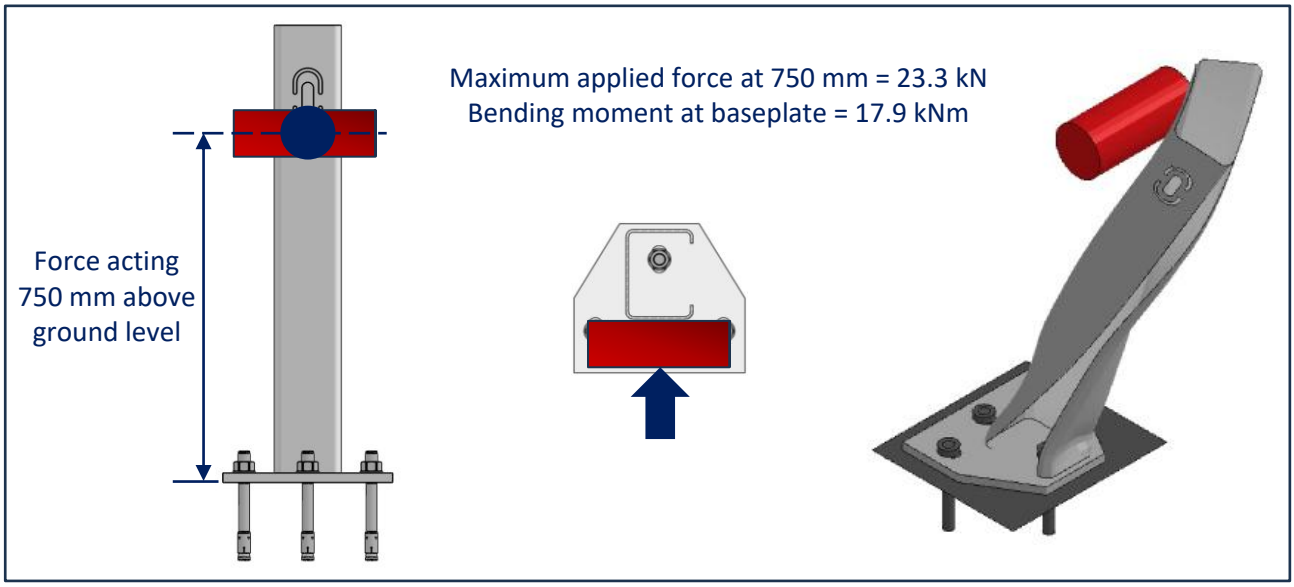


Figure 6: RamShield® HC Post Load Analysis.



Figure 7: Dynamic Load Impacts Validating Anchor Capacity.

6.13 Design Life

The durability of the finished hot dip galvanized coating is a function of the environment to which the article is exposed. According to industry standards, hot-dip galvanized coatings can last up to 50 years in rural environments and up to 25 years in more corrosive environments, such as coastal regions. These estimates are based on average environmental conditions, and the actual lifespan of a galvanized coating will depend on the specific conditions it is exposed to.

Example: The RamShield® HC post has a thickness of 4.3 mm. Hot dip galvanising will provide a minimum average coating thickness of 70 µm. When installed in a C3 environment, the coating will provide approximately 33 years until first maintenance.

Table 4: Coating Thicknesses, AS/NZS 4680.

Article Thickness, mm	Average Coating Thickness, µm	Average Coating Mass, g/m²
≤ 1.5	45	320
> 1.5 ≤ 3	55	390
> 3 ≤ 6	70	500
> 6	80	600

Table 5: Corrosivity Classifications, AS 4312.

Corrosivity Category	
CX	Severe Surf Shoreline
C5	Surf Seashore
C4	Calm Seashore
C3	Coastal
C2	Arid/Urban Inland
C1	Dry Indoors

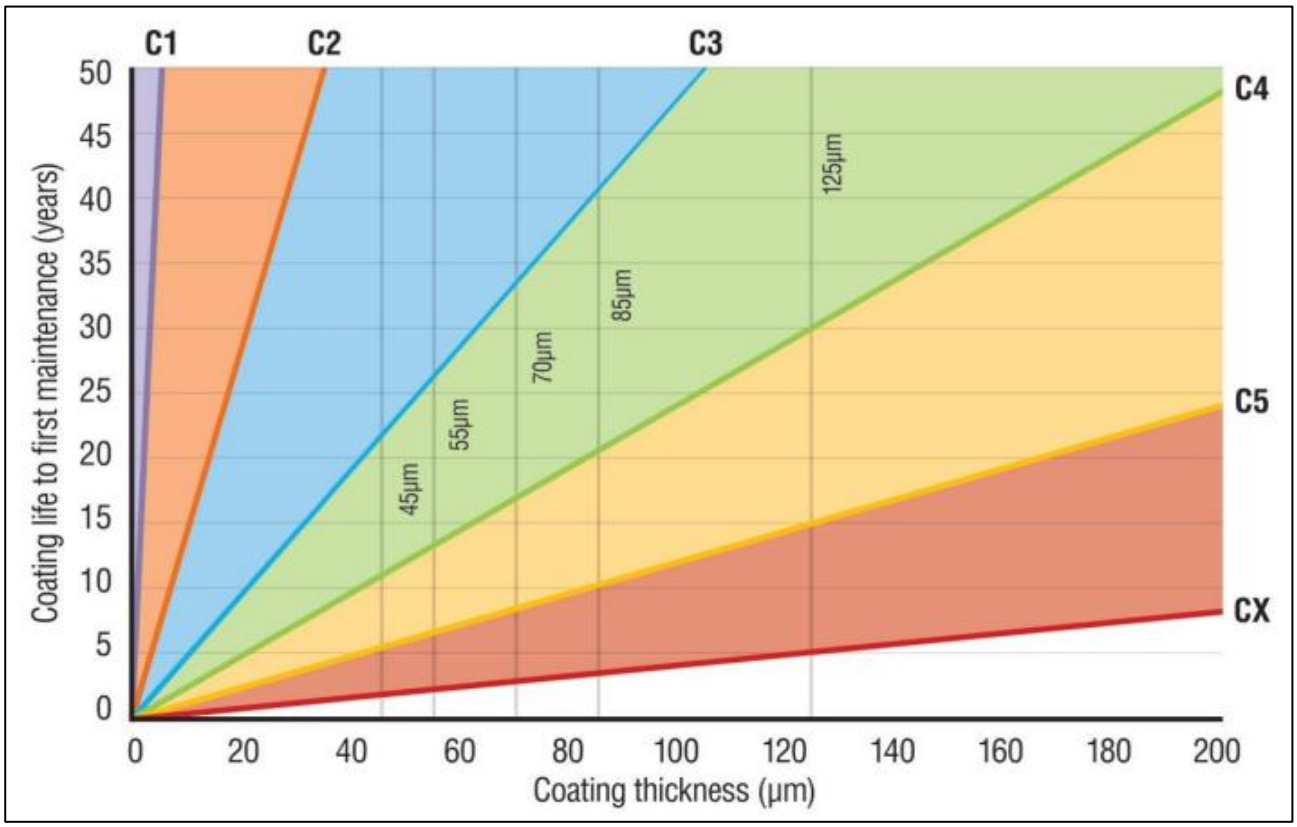


Figure 8: Calculated Corrosivity Rates for Hot Dip Galvanised Coatings, AS/NZS 2312.2.

7.0 Computer Simulation Analysis

Computer simulation analysis, also known as finite element analysis, has become an important tool in the development and assessment of crash barrier systems. Recent advances in computer hardware and finite element methodologies have given developers of crash barriers the ability to investigate complex dynamic problems involving vehicular impacts into safety barrier systems. Finite element analysis has been used extensively to evaluate both vehicle components and the crashworthiness of safety barriers and hardware.

Most computer simulation models use the LS-DYNA finite element code. LS-DYNA is a general-purpose, explicit finite element code and is widely used to solve nonlinear, dynamic response of three-dimensional problems and is capable of capturing complex interactions and dynamic load-time history responses that occur when a vehicle impacts a barrier system.

The MASH TL3 and TL4 full-scale crash test results of RamShield® HC have been numerically validated and verified in accordance with NCHRP Report 179 as required by the Austroads Safety Barrier Assessment Panel (ASBAP).

The RamShield® HC simulation model has been used by Safe Direction to evaluate incremental improvements including:

- Dynamic deflections and working widths at various impact speeds and impact angles.
- Omission of a single post due to an underground service which cannot be relocated, or the barrier realigned to avoid the service.
- The behaviour of the concrete beam when supporting posts with baseplates.
- Reduced post spacing.

Computer simulation analysis is not used to substitute compliance crash testing, however it has become a useful tool to assist designers and understand the impact performance of non-standard installation configurations.

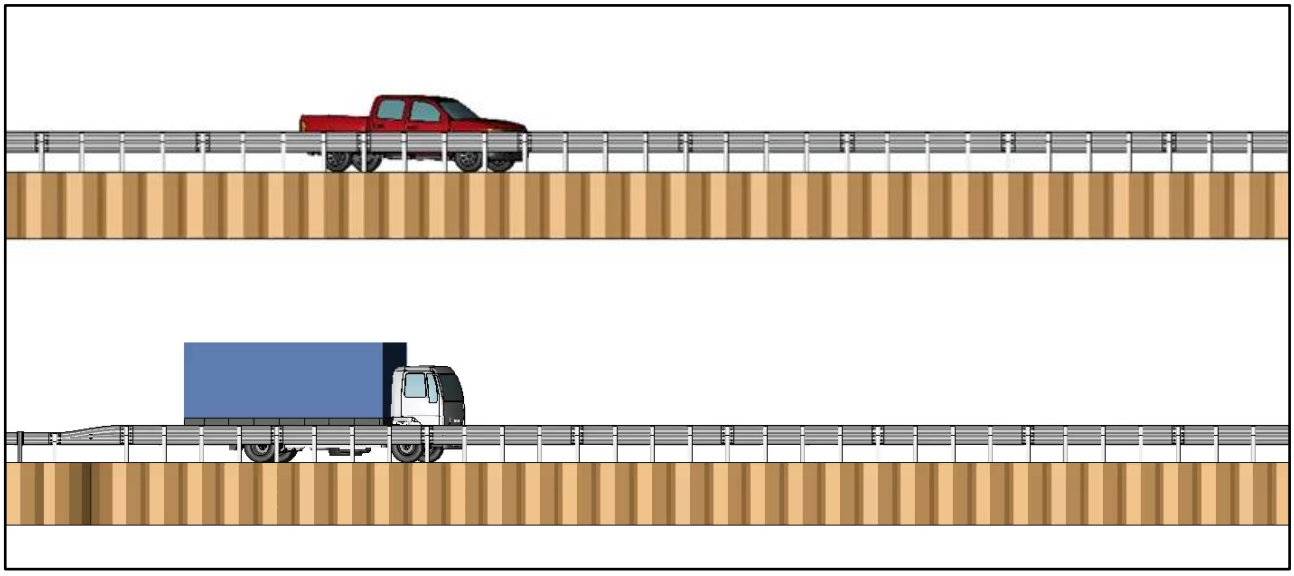


Figure 9: RamShield® HC Simulation Analysis.

8.0 Connections & Attachments

8.1 Connection to RamShield® W-Beam

The use of an asymmetric transition is required to transition from thrie-beam to w-beam guardrail. The asymmetric transition panel is 1905 mm 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 rail by 200 mm, making it compatible for use with RamShield® W-Beam and RamShield® Low Deflection which adopt a rail height of 800 mm above ground level.

When connecting to w-beam, RamShield® HC posts are installed at each end of the asymmetric transition as shown in Figure 11.

Note: The 1905 mm (6'3") nett laying length of the asymmetric transition differs from the standard 2 m post spacing of RamShield® HC and RamShield® W-Beam.

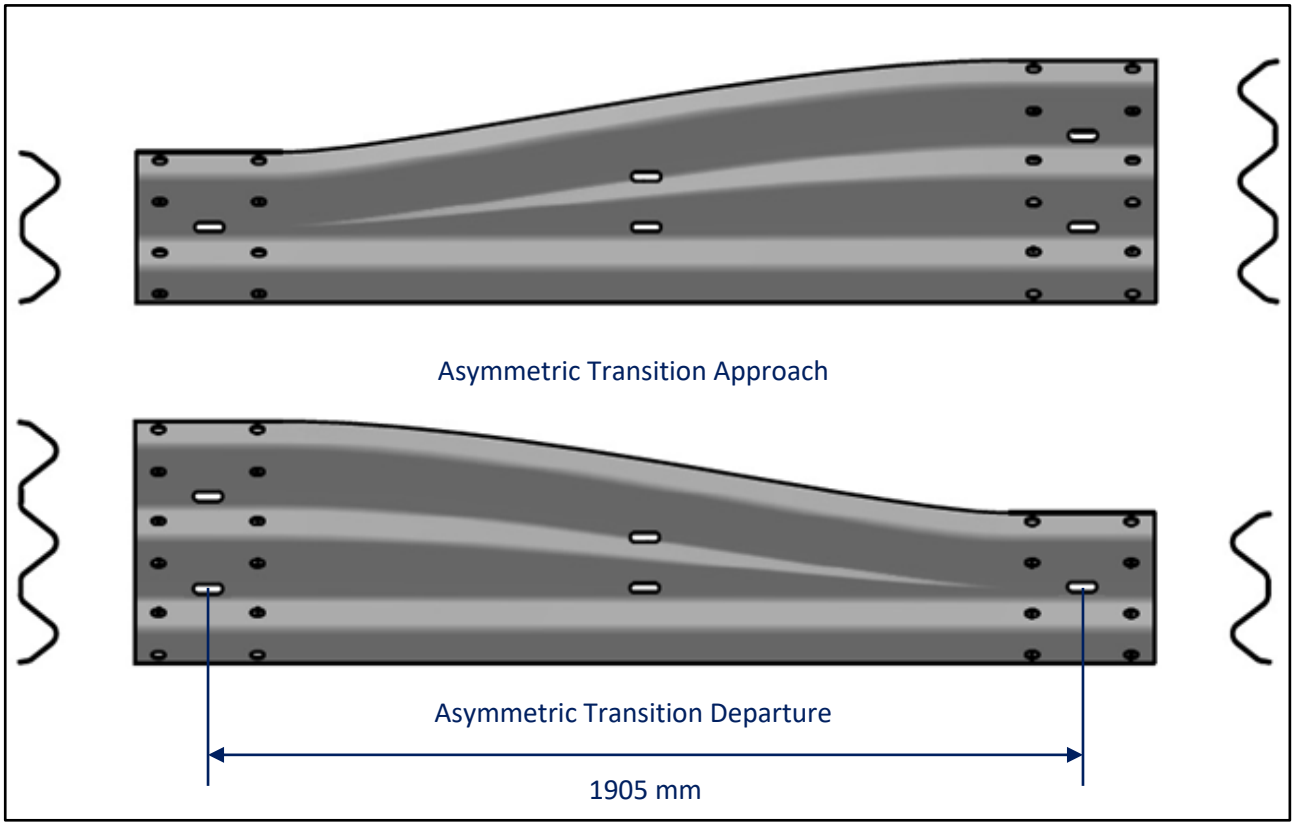


Figure 10: Asymmetric Transitions.

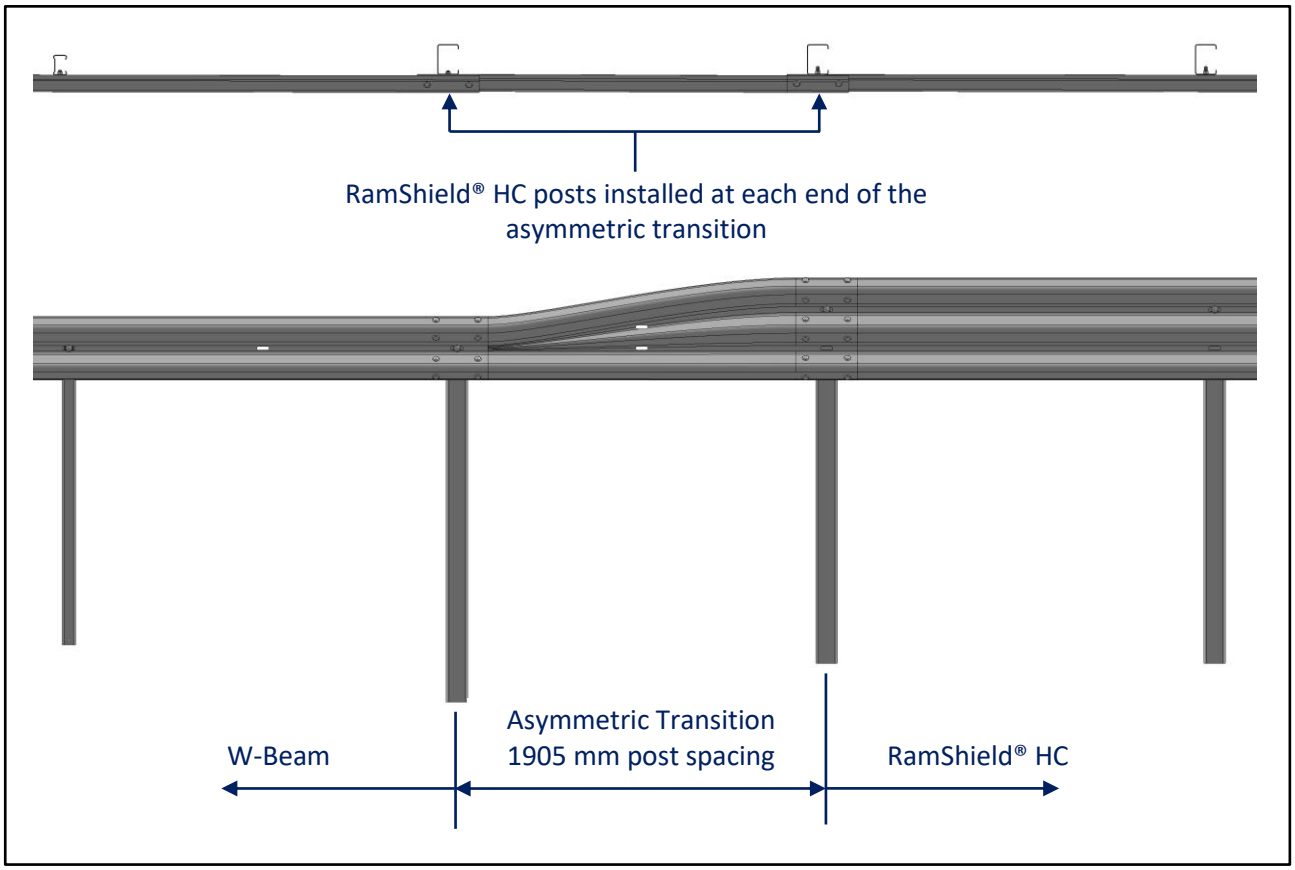


Figure 11: RamShield® HC, Connection to W-Beam.



8.2 Connection to End Terminals

MASH compliant end terminals are designed to minimise the severity of impacts occurring at the end of the safety barrier system. They also 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.

Guardrail end terminals are installed using w-beam guardrail, therefore it is necessary to transition from thrie-beam using an asymmetric transition, as described in Section 8.1, before commencing installation of the end terminal. Thrie-beam cannot be used within the end terminal section.

Note: The upper limit for the crash test assessment of guardrail end terminals is MASH Test Level 3.



8.3 Connection to a Rigid Barrier

Wherever it is necessary join RamShield® HC to a rigid barrier, the interface must be designed to ensure that the overall system will perform safely when impacted by a design vehicle.

The MASH TL3 compliant RamShield® Transition provides a smooth, snag-free connection between RamShield® HC and rigid barriers, including concrete abutments and the CrocGuard® Bridge & Culvert Barrier. The RamShield® Transition gradually increases stiffness of the system reducing the potential for vehicle pocketing.

The RamShield® Transition features 3.5 mm thick thrie-beam guardrail supported by RamShield® HC posts at reduced spacings. The RamShield® Transition adopts the same system height as RamShield® HC, simplifying connection between the two systems.

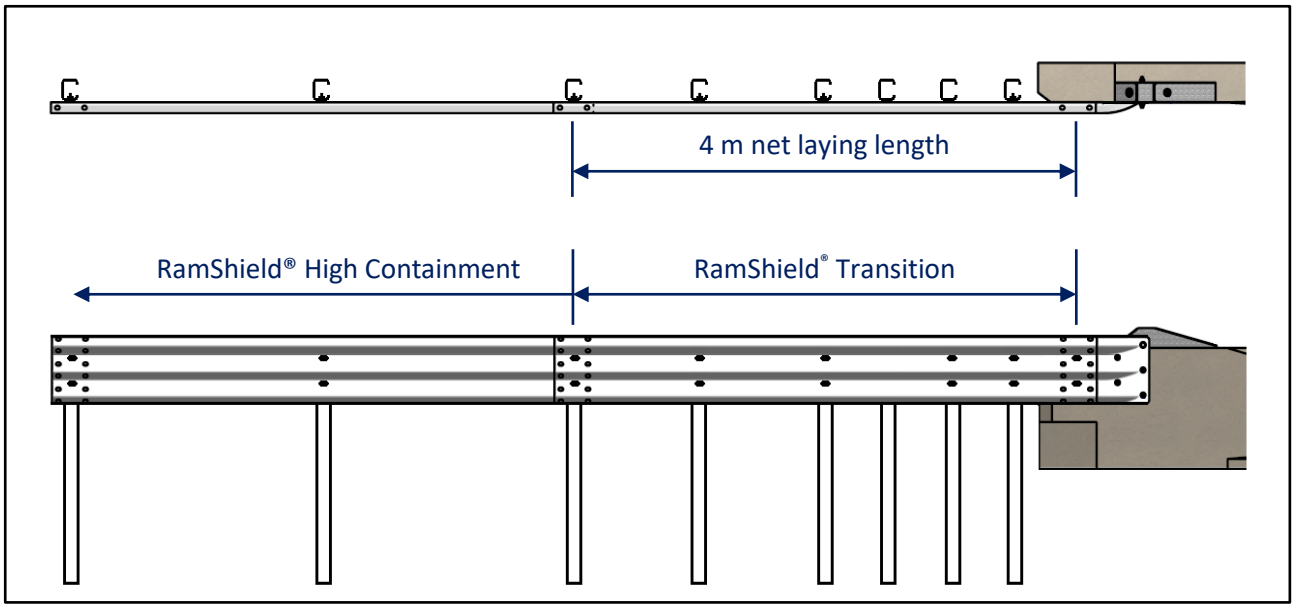


Figure 12: RamShield® HC, Connection to a Rigid Barrier using the RamShield® Transition.



8.4 Attachment of BikerShield™

BikerShield™ is a motorcyclist safety barrier system designed to reduce the impact severity for riders when colliding with a roadside guardrail barrier. BikerShield™ is positioned below the guardrail beam and prevents a dismounted motorcyclist from contacting the supporting posts of the guardrail barrier system.

BikerShield™ provides safe rider containment and redirection through the combination of spring mounting brackets and lightweight, corrugated panels. The spring brackets attach directly to the guardrail beam mid-span between posts and absorbs the impact energy of the sliding rider.

The position of BikerShield™ beneath the guardrail beam prevents rider contact with the posts and provides forgiving containment and redirection. The BikerShield™ mounting bracket position is an important design consideration as vertical alignment with the face of the guardrail beam reduces the potential for rider snagging.

Since the BikerShield™ mounting brackets are secured to the rear of the guardrail beam mid-span between posts, thrie-beam rails manufactured by Safe Direction are pre-punched at 1 m centres to facilitate ease of installation.

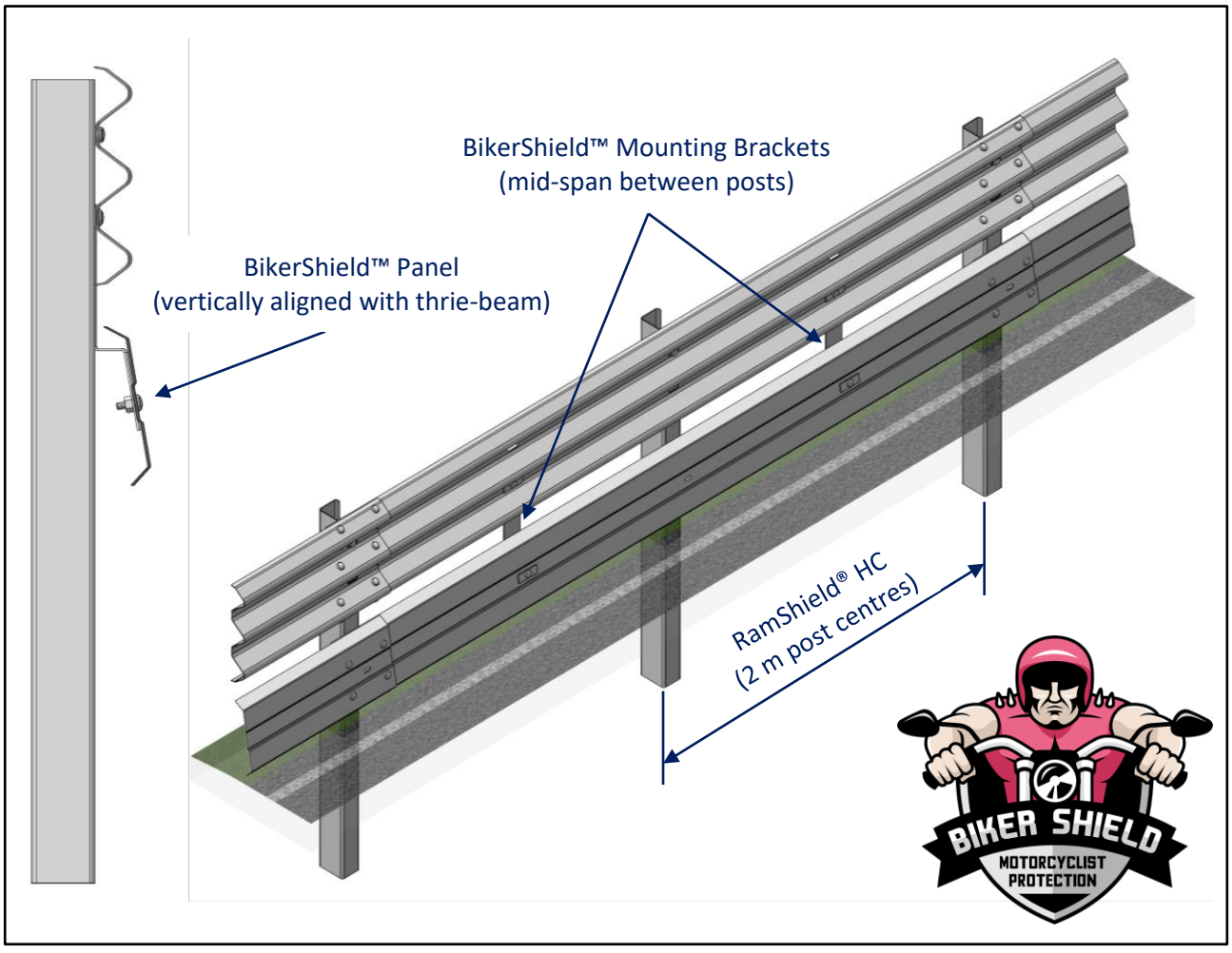


Figure 13: RamShield® HC, Attachment of BikerShield™.

9.0 RamShield® Edge

RamShield® Edge is a variation to RamShield® HC providing MASH TL4 compliance for installations on the hinge point of a 1:1 weak soil embankment.

RamShield® Edge restrains the RamShield® HC posts by using a pin that is driven back into the road formation at approximately 45° and is clamped to the post just below ground level. The RamShield® Edge pin is anchored in front of the barrier system therefore not relying upon lateral support behind the post. This restraint mechanism is independent of soil type, compaction level or batter geometry behind the post.

The RamShield® Edge pin prevents below-ground post movement allowing the post to yield by bending at ground level, replicating post behaviour in flat, well-compacted terrain. RamShield® Edge prevents the post from rotating through the back of the embankment, limits barrier deflection and facilitates safe vehicle containment and redirection.

The RamShield® Edge pins remained anchored into the road formation and were reused during full-scale crash testing. The restraint capacity of the RamShield® Edge pins can be validated on-site using the mobile THOR apparatus which performs a high-energy, dynamic impact.

RamShield® Edge is an economical alternative to expensive shoulder widening and embankment stabilisation. Positioning the barrier on the hinge batter conserves valuable vehicle lane width and retains important recovery space between the edge of the travelled way and the barrier.

Thrie-beam systems provide numerous performance advantages when compared with w-beam systems when installed near embankments. A thrie-beam system provides lower dynamic deflection, a wider lateral catching area and deeper post embedment when compared with w-beam systems. Furthermore, a higher rail height provides improved stability for high-centre-of-gravity vehicles and thrie-beam systems are less prone to vehicles under-riding the system.

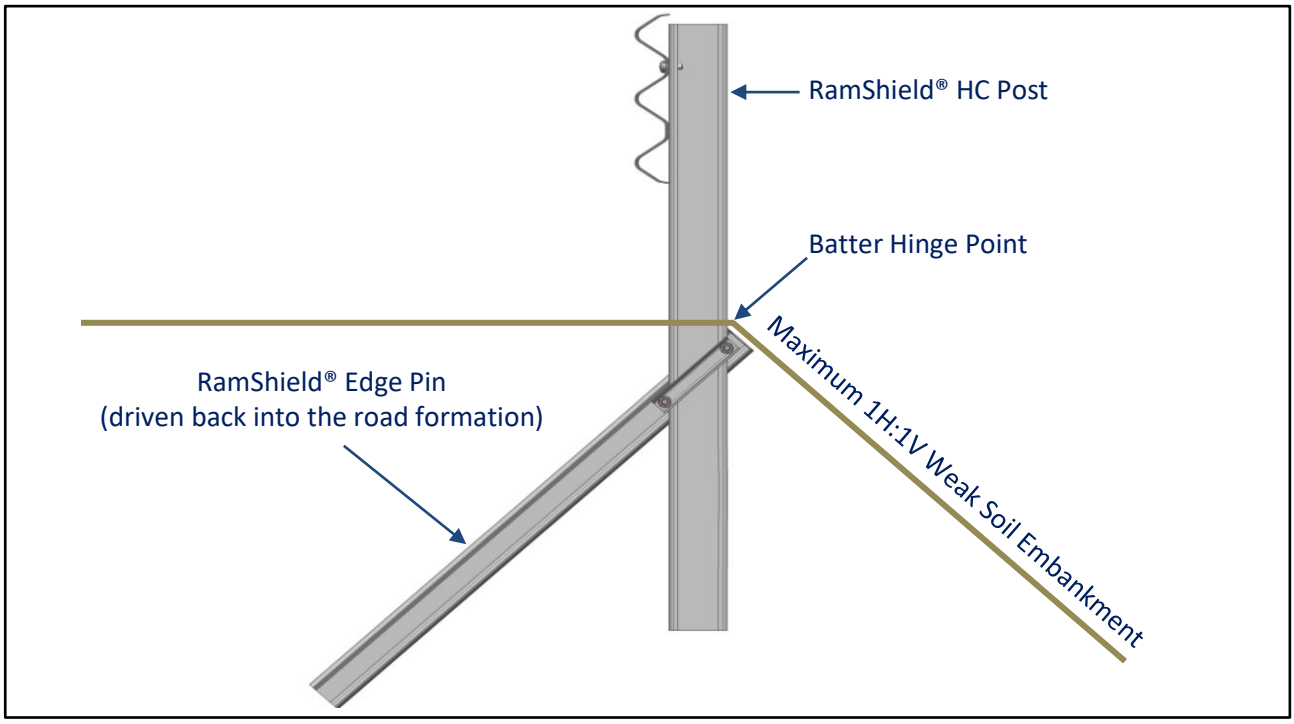


Figure 14: RamShield® Edge.



Figure 15: Dynamic Load Impacts Validating Pin Strength.

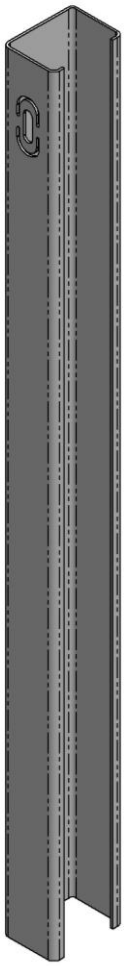


Figure 16: RamShield® Edge Pin.



Figure 17:RamShield® Edge, Evaluated on the Hinge Point of a 1:1 Weak Soil Embankment.

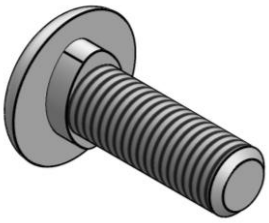
10.0 Component Identification (not to scale)



1860 mm
RamShield® HC Post
24 kg



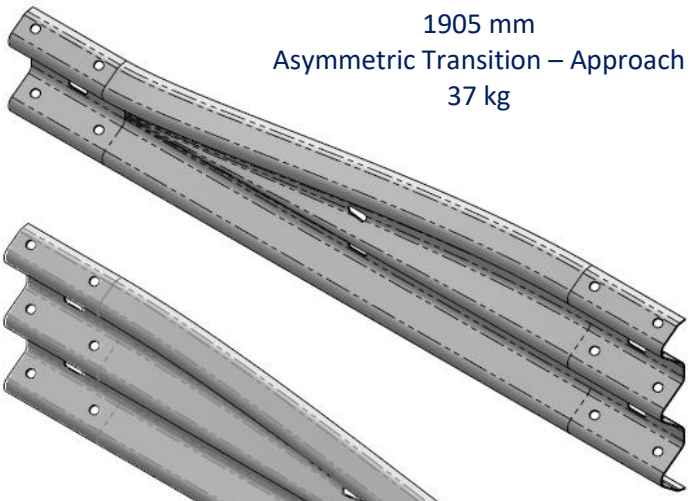
M16 x 32 mm
Mushroom Head Bolt



M16 x 50 mm
Mushroom Head Bolt

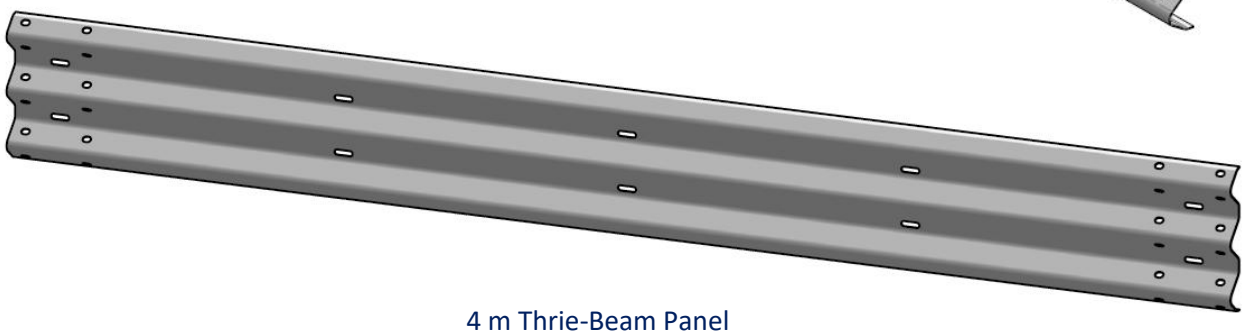


M16 Oversize Nut



1905 mm
Asymmetric Transition – Approach
37 kg

1905 mm
Asymmetric Transition – Departure
37 kg



4 m Thrie-Beam Panel
67 kg

11.0 Tools Required

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

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

11.1 Recommended PPE

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

- Safety footwear.
- Gloves.
- Hearing protection.
- High visibility clothing.



- PPE as required for the use of post driving equipment or auger.

12.0 Site Establishment

12.1 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.

12.2 Underground Services

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

12.3 Overhead Obstructions

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

12.4 Unloading Exclusion Zone

Only appropriate load-rated slings and chains should be used for the safe unloading of product. 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.

13.0 Installation

The major steps in the installation of RamShield® HC are as follows:

- Set-out.
- Installing the approach terminal.
- Installing the approach asymmetric transition.
- Installing the C-posts.
- Attachment of the thrie-beam guardrail.
- Installing the departure asymmetric transition.
- Installing the departure terminal.

13.1 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:

- RamShield® HC does not use offset blocks. The width of the system is just 235 mm.
- The standard post spacing of RamShield® HC is 2.0 m centres.
- The post spacing of the asymmetric transitions is 1.905 m centres.
- The system width of RamShield® HC may differ from the system width of the end terminals and transitions.
- The RamShield® HC posts are not to be installed within the guardrail end terminal region.

13.2 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 C-posts may be installed by:

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

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

13.3 Attaching the Thrie-Beam Rails

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.*

Thrie-beam guardrails manufactured by Safe Direction are punched at 1 m centres providing compatibility with BikerShield™ motorcycle protection barrier. Each thrie-beam rail features an upper and lower mounting slot. The attachment of the thrie-beam rails to the C-posts is achieved with the post bolt passing through the upper slot only.

The rails are secured to the C-posts using a M16 x 50 mm mushroom head bolt and oversize nut. The oversize nut is tightened using a hand socket and 32 mm attachment.

The thrie-beam lap is orientated so that the leading edge of the splice is shielded from the nearside approaching traffic. Rails are spliced together using twelve (12) standard M16 x 32 mm mushroom head bolts and oversize nuts. The oversize nuts are tightened using a battery drill driver and 32 mm 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 C-posts, the finishing height of the thrie-beam will be approximately 30 mm above the top of the C-posts.

Note: *A M16 x 32 mm mushroom head bolt may be used as an alternative to secure the rails to the C-posts.*

13.4 Delineation

The RamShield® HC delineator is positioned on the top corrugation of the thrie-beam panel and secured under a splice bolt. The use of delineators is project specific and considers driver line-of-sight and barrier offset.



Figure 18: Attachment of Delineation.

14.0 Curving of Thrie-Beam Rails

Thrie-beam guardrail barriers perform well on the outside of curves, even those of relatively small radius, as the concave shape (in plan view) supports the development of tension in the thrie-beam rail.

In the field, straight sections of thrie-beam can be used to form a radius of 45 m or greater. When a radius of less than 45 m is required, the thrie-beam rails are required to be factory curved.

For ordering purposes, the orientation of curvature and radius is required. Alternately, providing the chord length (C), the height of rise (H) or angle (Ø) will allow Safe Direction to calculate the radius of curvature.

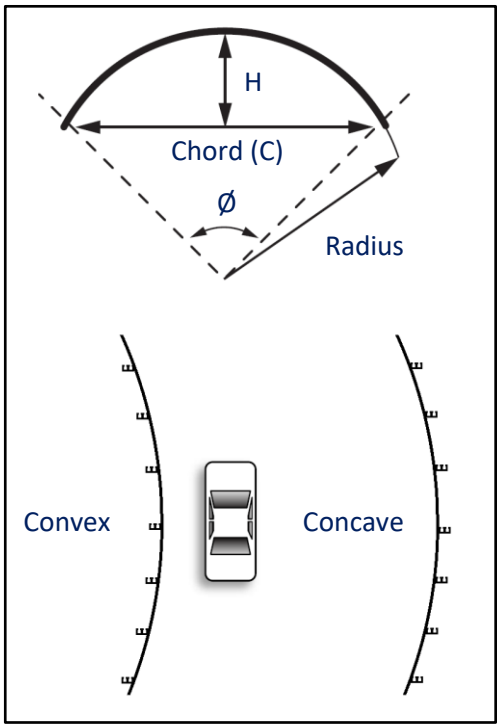


Figure 19: Curving Orientation.

15.0 Recommended Tolerances

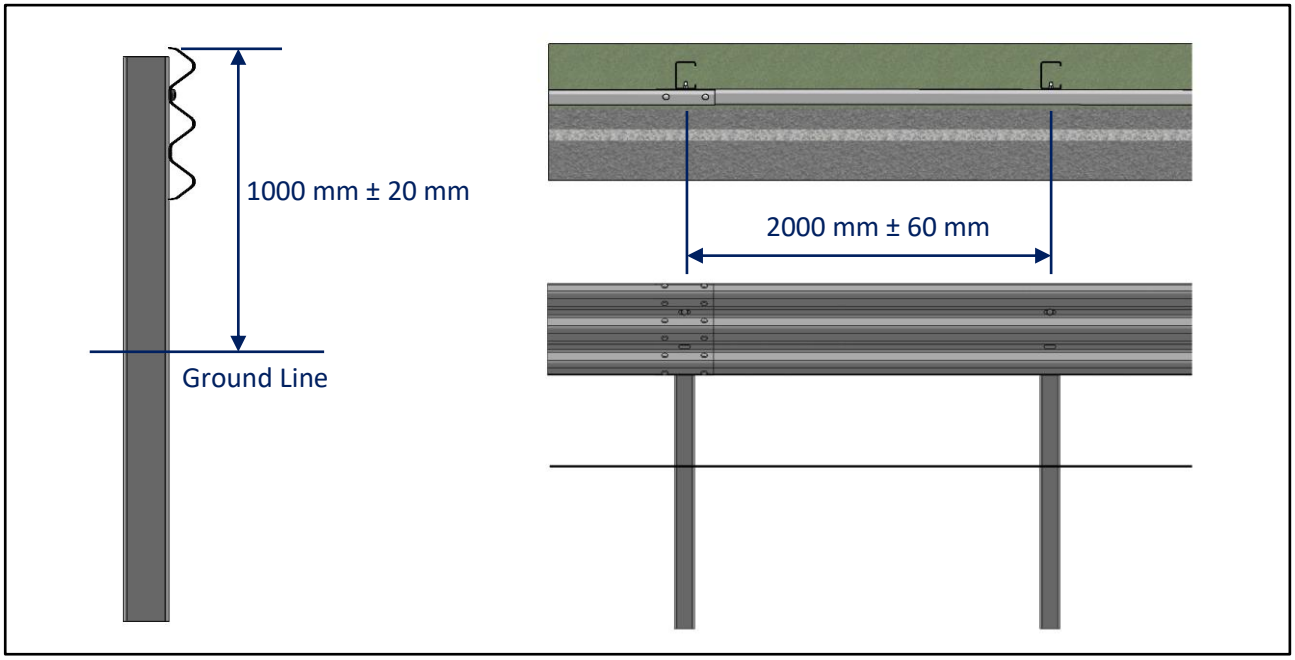


Figure 20: Recommended Tolerances.



Inspection Form

Inspection Date	
Client	
Project Reference	
Name of Inspector	
Company	

❑ Yes ❑ No	The system is suitably anchored with approved state road agency end terminals.
❑ Yes ❑ No	Asymmetric transitions are used to connect to w-beam guardrail.
❑ Yes ❑ No	The C-posts are spaced at maximum 2.0 m centres.
❑ Yes ❑ No	The height measured to the top of the C-posts is approximately 970 mm.
❑ Yes ❑ No	The C-posts are correctly orientated with the release tab on the traffic side.
❑ Yes ❑ No	The height measured to the top of the thrie-beam rails is 1000 mm ± 20 mm.
❑ Yes ❑ No	The thrie-beam rail is secured to each C-post with a M16 x 50 mm (or 32 mm) mushroom head bolt & oversize nut.
❑ Yes ❑ No	The thrie-beam rails are spliced with twelve (12) M16 x 32 mm mushroom head bolts & oversized nuts.
❑ Yes ❑ No	The thrie-beam rail lap is orientated so that the leading edge of the splice is shielded from approaching traffic.
❑ Yes ❑ No	All bolts are tightened.
❑ 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 barrier is appropriately delineated (if required).
❑ Yes ❑ No	The area around the barrier is free of debris.

Comments/Notes

16.0 Maintenance

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

- The barrier is appropriately delineated (if required).
- 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.
- The anchor assembly at the end terminals is taut and the bearing plate is correctly aligned.

16.1 Bushfire Damage

RamShield® HC is constructed from hot dip galvanised steel components. The performance of hot dip galvanised components when subjected to a fire depends upon numerous factors such as flame duration, flame intensity and the characteristics of the galvanised finish.

Bushfires can produce high temperatures, however exposure of roadside structures to maximum flame intensity is generally for a short duration as the fire front moves forward. The combination of the reflectivity of the galvanised surface and the heat sink provided by the mass of the steel to which the hot dip galvanising is applied has shown galvanised steel to provide excellent performance during bushfires.

If it is observed that a bushfire has caused damage to the galvanised coating it is recommended that these item(s) be replaced.

17.0 Repair

In the event of a vehicle impact, damage to the barrier is to be assessed in accordance with Table 6. Typically, impacts with RamShield® HC will require replacement of damaged sections of rails and C-posts. It is also recommended that new bolts be used where rails and C-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.
- Post extractor.

Similar to the installation sequence, it is recommended that the guidelines contained in Section 12.0 be observed in the establishment of traffic control and an unloading exclusion zone in addition to an investigation for underground services and overhead obstructions.

17.1 Removing the Thrie-Beam Rails

Potential Hazards: *Injury from movements and posture, hand injury from pinch points, strain to wrists from loosening 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 an impact drill to loosen bolts and wear appropriate hearing protection.*

Using a battery drill driver and 32 mm attachment, loosen the twelve (12) M16 oversize nuts and remove the M16 x 32 mm mushroom head splice bolts.

Remove the M16 x 50 mm mushroom head bolt and oversize nut securing the thrie-beam rail to the C-posts.

17.2 Removing the C-Posts

Potential Hazards: *Use of post extracting 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).*

Posts should be removed using an appropriate post extractor. Once the post is removed, the ground material should be suitably compacted.

17.3 Material Disposal

RamShield® HC features an all steel construction. Damaged items may be recycled.



18.0 Dismantling

Should RamShield® HC require dismantling, it is recommended that the guidelines contained in Section 12.0 be observed in the establishment of traffic control in addition to an investigation for underground services and overhead obstructions.

Table 6: Damage Assessment Guidelines.

Type of Damage	Description of the Damage	Remedial Action
Damage to the galvanised coating on the C-posts.	The sum total of the damaged area does not exceed 70 cm^2 (0.5% of the total surface area) and no individual damaged area exceeds 40 cm^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 70 cm2 (0.5% of the total surface area) or an individual damaged area exceeds 40 cm^2.	The post is to be replaced.
Damage to the galvanised coating on the rails.	The sum total of the damaged area does not exceed 250 cm^2 (0.5% of the total surface area) and no individual damaged area exceeds 40 cm^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 250 cm^2 (0.5% of the total surface area) or an individual damaged area exceeds 40 cm^2.	The rail is to be replaced.
Damage to the C-posts.	The C-post is bent.	The C-post is to be replaced.
Damage to the post tab.	The tab has distorted and released the post bolt.	The C-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.