HammerBeam™

Bridge & Culvert Barrier

SafeDirection
CRASH BARRIER SOLUTIONS

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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

Complies with AS/NZS 5100.1:2017 Bridge design (Low Performance Barrier)

Crash tested on the edge of an elevated concrete beam

Crash tested behind a 200mm hob

Superior Design

Yielding RamShield® posts prevent damage to the culvert or bridge structure

Eliminates the requirement for bespoke barrier designs

Available with side mount or surface mount posts

Maximises usable bridge & culvert width reducing centreline crowding

Rapid post replacement following design impacts

Simplified Installation

Uses standard thrie-beam rails and RamShield® posts

Standard 2m post spacing

Simple transition for upstream and downstream connection to w-beam

Crash tested using mechanical anchors

1.0 Introduction

HammerBeam™ is the latest innovation and advancement in elevated barrier designs suitable for bridges and culverts. Developed by Safe Direction, HammerBeam™ has been full-scale crash tested to MASH Test Level 3.

Providing a forgiving roadside environment reduces the consequences for vehicles leaving the safe, travelled way. HammerBeam™ has been specifically designed and evaluated for installation along the edge of an elevated structure, demonstrating safe containment and redirection of a 2270kg pick-up truck travelling at 100km/h and 25 degrees.

Safe Direction has significantly advanced the performance of guardrail barriers for bridge or culvert applications by combining the strength of thrie-beam guardrail with the yielding behaviour of the RamShield® W-Beam post.

The use of standard, off-the-shelf components simplifies installation, reduces costs and provides compatibility with an upstream and downstream MASH compliant guardrail barrier.

The yielding behaviour of the RamShield® post prevents damage to the bridge or culvert structure, a primary design consideration for asset owners.

2.0 Risk of Rigid Post Systems

Traditionally, rigid post systems used as roadside barriers have been modified for attachment to culvert and bridge structures. However, the majority of these barrier designs are not crash tested and use overly simplistic load criteria.

Without crash testing, the dynamic interaction between the errant vehicle and the barrier as it deflects beyond the edge of the elevated structure is unknown and presents a risk to vehicle occupants.

In addition, barrier systems featuring rigid posts will typically overload the anchors upon impact from an errant vehicle. This results in damage to the concrete structure which is problematic and a cause of corrosion. The life span of the structure may be comprised as steel reinforcement becomes damaged or exposed to atmospheric contaminants and water.

Figure 1: Failure of Rigid Post Systems Causing Significant Damage.

3.0 How HammerBeam™ Works

HammerBeam™ combines the strength of thrie-beam guardrail with the yielding behaviour of the RamShield® W-Beam post.

The triple corrugation design feature of thrie-beam provides numerous advantages when installed along the edge of an elevated structure:

- Lower deflection.
- Wider lateral catching area.
- Less prone to vehicles under-riding the system.
- Higher rail height providing improved stability for high-centre-of-gravity vehicle.
- Increased strength and capacity.

The RamShield® post achieves a controlled redirection of errant vehicles by releasing the rail 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 post. The tab is designed to pull forward and tear from the post and remains connected to the rail to ensure there is no debris from the system that may otherwise present as a danger to other motorists.

The RamShield® post is designed to collapse upon impact distinguishing it from heavier, rigid post systems which become problematic when attached to concrete structures.

The yielding performance of the RamShield® post reduces forces transferred to the elevated structure preventing damage and facilitating ease of repair.

The working mechanism of the RamShield® post is a patented concept designed and developed by Safe Direction. The concept is the latest innovation in guardrail design and sets a new benchmark in simplicity and performance.

Figure 2: Yielding Behaviour of the RamShield® Post.

4.0 Crash Test Performance

HammerBeam™ 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 safety barrier systems as stated in *AS/NZS 3845.1: 2015 Road Safety Barrier System and Devices* and *AS 5100.1:2017 Bridge Design.*

The MASH TL3 crash test matrix requires the following impacts:

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

The crash test evaluation of HammerBeam™ to MASH TL3 (156.4kJ) significantly exceeds the MASH TL2 impact energy (76.6kJ) nominated for Low Performance Barriers as described in AS 5100.1:2017

HammerBeam™ was crash tested when positioned on the edge of a concrete beam representing a bridge or culvert installation. Material behind the concrete beam was excavated preventing the test vehicles from contacting the ground behind the barrier. This ensures vehicle redirection behaviour is thoroughly evaluated as the barrier deflects beyond the edge of the elevated concrete beam.

Crash testing was performed with and without a 200mm high hob installed along the edge of the elevated concrete beam representing real-life scenarios and assessing the potential for vehicle vaulting during containment and redirection.

The crash testing of HammerBeam™ when positioned on the edge of an elevated concrete beam distinguishes HammerBeam™ from roadside barriers which have been assessed with posts supported laterally in soil and/or evaluated on flat terrain.

Conventional guardrail systems, including their baseplate variants, should be restricted to sites with sufficient clearance behind the barrier to accommodate dynamic deflection. This makes these systems unsuitable for installation on the edge of elevated structures.

Figure 3: Crash Test Assessment of HammerBeam™ on the Edge of an Elevated Concrete Beam.

5.0 Design Considerations

5.1 Side Mount Posts

HammerBeam™ may be installed with posts secured to the side of an elevated concrete structure maximising usable bridge and culvert width, reducing the potential for centreline crowding.

The side mount option features a bracket containing a recess for insertion of the RamShield® post. Once the bracket is secured to the side of the structure, the standard length RamShield® post (1560mm) is cut to the required length on site and inserted into the recess.

This design feature provides numerous benefits including:

- Use of standard components.
- Ability to adjust the vertical position of the bracket to suit site specific requirements e.g. interference with reinforcement.
- The height of the system is adjusted on site to suit finished road levels.
- Impacted posts do not damage the mounting brackets.

The mounting bracket design and anchoring exceeds the bending capacity of the RamShield® post. Following a vehicle impact the damaged RamShield® posts are simply removed from the mounting brackets and replaced.

5.2 Surface Mount Posts

HammerBeam™ may be installed with posts on baseplates secured to the top of an elevated concrete structure at sites where access to the side of the structure may be restrictive.

The baseplate design and anchoring exceeds the bending capacity of the RamShield® post. Following a vehicle impact the damaged post is simply removed from the anchors and replaced.

5.3 System Installed Height

HammerBeam™ is installed with the thrie-beam positioned 980mm ± 20mm above road pavement level. The thrie-beam rail is positioned approximately 50mm above the top of the RamShield® post.

5.4 Kerbs

Bridge and culvert structures often feature kerbing to facilitate drainage. The installation of barriers behind kerbs may affect the vehicle trajectory and safe containment and redirection.

HammerBeam™ has been crash tested to MASH TL3 directly behind a 200mm high hob. The hob featured a vertical face and crash testing was performed with both the 2270kg pick-up truck (2270P) and 1100kg passenger car (1100C) travelling at 100km/h and 25 degrees representing ‘worst practical conditions’ to evaluate the potential for vehicle launching.

In both impact conditions the test vehicles were safely contained and redirected satisfying all MASH criteria.

For sites where the kerb height exceeds 200mm, installation of HammerBeam™ should be at the discretion of the Project Manager noting that most alternate barrier designs are not crash tested solutions.

5.5 Minimum Installation Length

The crash tested length of HammerBeam™ is not meant to reflect minimum installation length.

The HammerBeam™ length of 20m installed along the edge of the elevated concrete beam adopted for MASH TL3 crash testing was selected to ensure vehicle containment and redirection occurred within the elevated beam length representing ‘worst case impact scenario’.

Shorter installation lengths of HammerBeam™ will reduce vehicle interaction with the elevated edge of the structure. For practicality, a minimum HammerBeam™ length of 4m, supported by three (3) posts is recommended.

5.6 Post Spacing

The crash tested post spacing of HammerBeam™ was 2.0m centres.

5.7 End Terminals

End terminals are designed to anchor the guardrail system and introduce the necessary tensile and flexural strength required for safe vehicle containment and re-direction throughout the length-of-need section.

Some guardrail end terminals also provide the additional feature of reducing the severity of an impact near or at the end of the system.

It is recommended that HammerBeam™ be anchored at the leading and trailing end of the installation with MASH compliant end terminals, such as the MSKT.

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

5.8 The Point-of-Need

HammerBeam™ is designed to safely contain and re-direct errant vehicles when installed along the edge of an elevated structure. The point-of-need is the location where the barrier system becomes re-directive.

When installed in combination with MASH TL3 compliant guardrail end terminals, the TL3 point-of-need of the barrier system will correspond to the end terminal point-of-need.

The point-of-need of a MSKT terminal is post location 3, a distance of 3.81m downstream from the start of the terminal.

5.9 Connecting to W-Beam

HammerBeam™ features thrie-beam guardrail positioned along the edge of an elevated structure.

The use of an asymmetric transition is required to transition from thrie-beam to w-beam guardrail for installation of an end terminal or continuation of the safety barrier system.

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 decreases the height of the system by 200mm providing compatibility with RamShield® W-Beam or MASH compliant end terminals.

The asymmetric transition is installed using RamShield® HC posts at the leading and trailing end of the transition.

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

5.10 Bi-Directional Impacts

The RamShield® posts used in the assembly of HammerBeam™ are also used in the assembly of RamShield® W-Beam.

Full-scale crash testing of RamShield® W-Beam has been undertaken with the posts installed in the reverse direction representing a vehicle crossing the road centreline. The outcome of crash testing demonstrated the RamShield® post tab controls the release of the rail during a vehicle collision regardless of post orientation.

This makes HammerBeam™ featuring RamShield® posts a suitable solution for installations on undivided roadways where reverse direction impacts may occur.

5.11 Post Loading Capacity

HammerBeam™ features RamShield® posts designed to yielding during impact. The RamShield® posts yield at lower forces when compared to rigid posts preventing damage to the bridge or culvert structure during a vehicle collision. The mounting bracket, baseplate and anchors are designed to exceed the bending capacity of the post as demonstrated through MASH TL3 crash testing.

When retrofitting HammerBeam™ to an existing bridge or culvert structure, the structural capacity of the elevated structure may be unknown or unreliable.

To assist designers, Safe Direction has undertaken RamShield® post capacity analysis using LS-Dyna. Analysis was undertaken for side-mounted posts and baseplate posts using four (4) load conditions as described in Figures 4, 5 & 6. This ensures the maximum loading condition is identified.

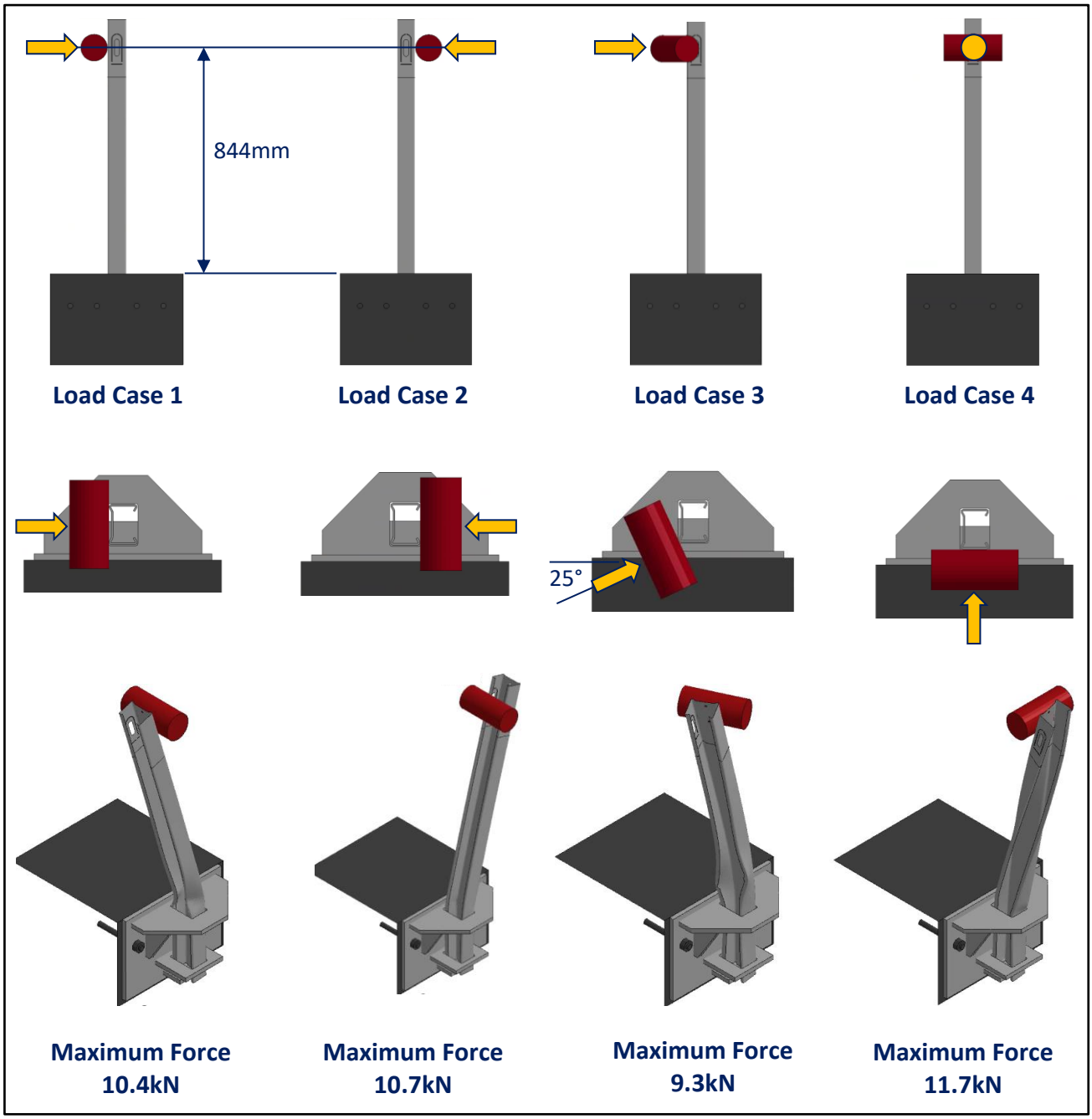


Figure 4: Load Analysis: Side Mount Posts.

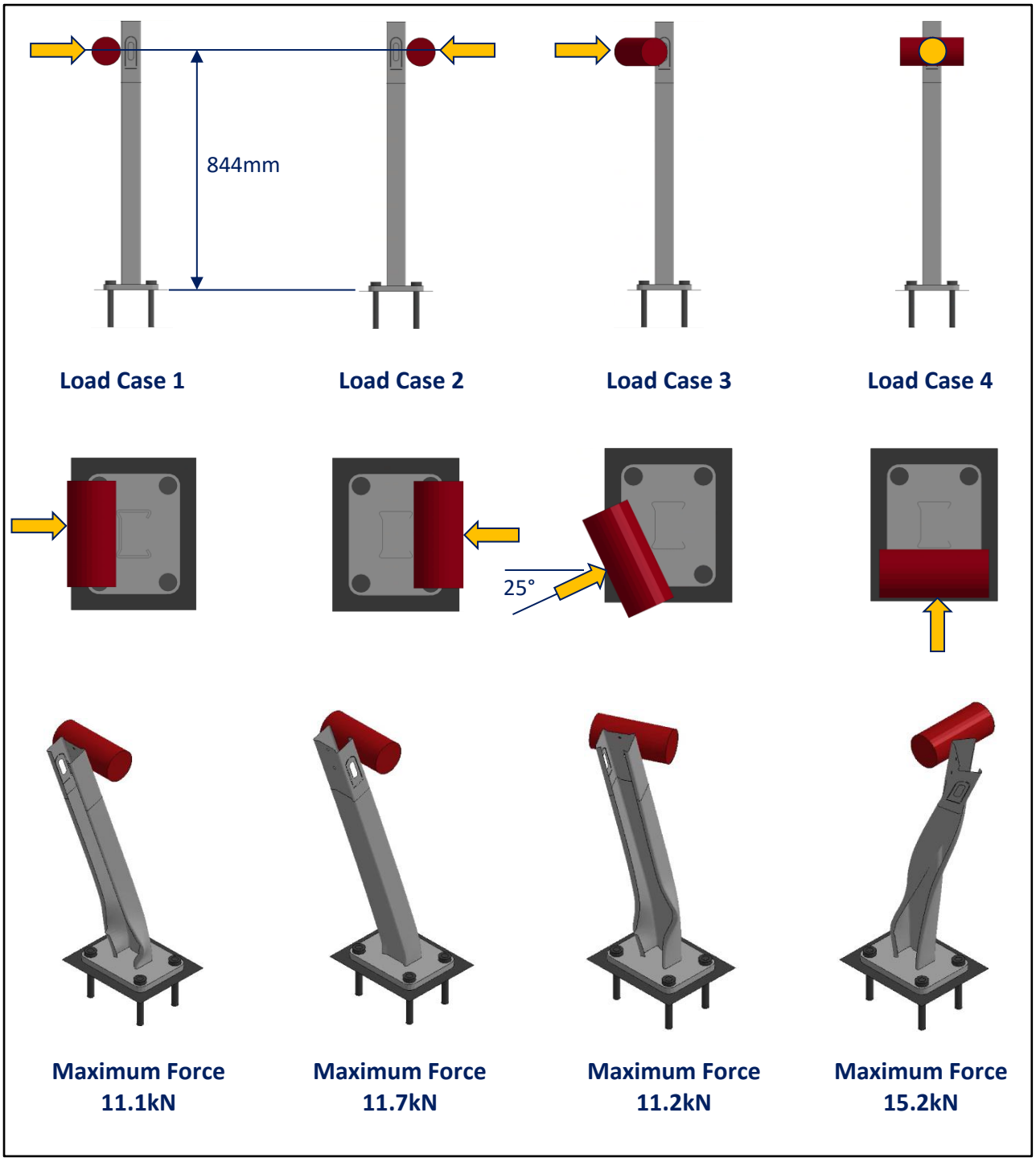


Figure 5: Load Analysis: Baseplate Posts Positioned at Road Level

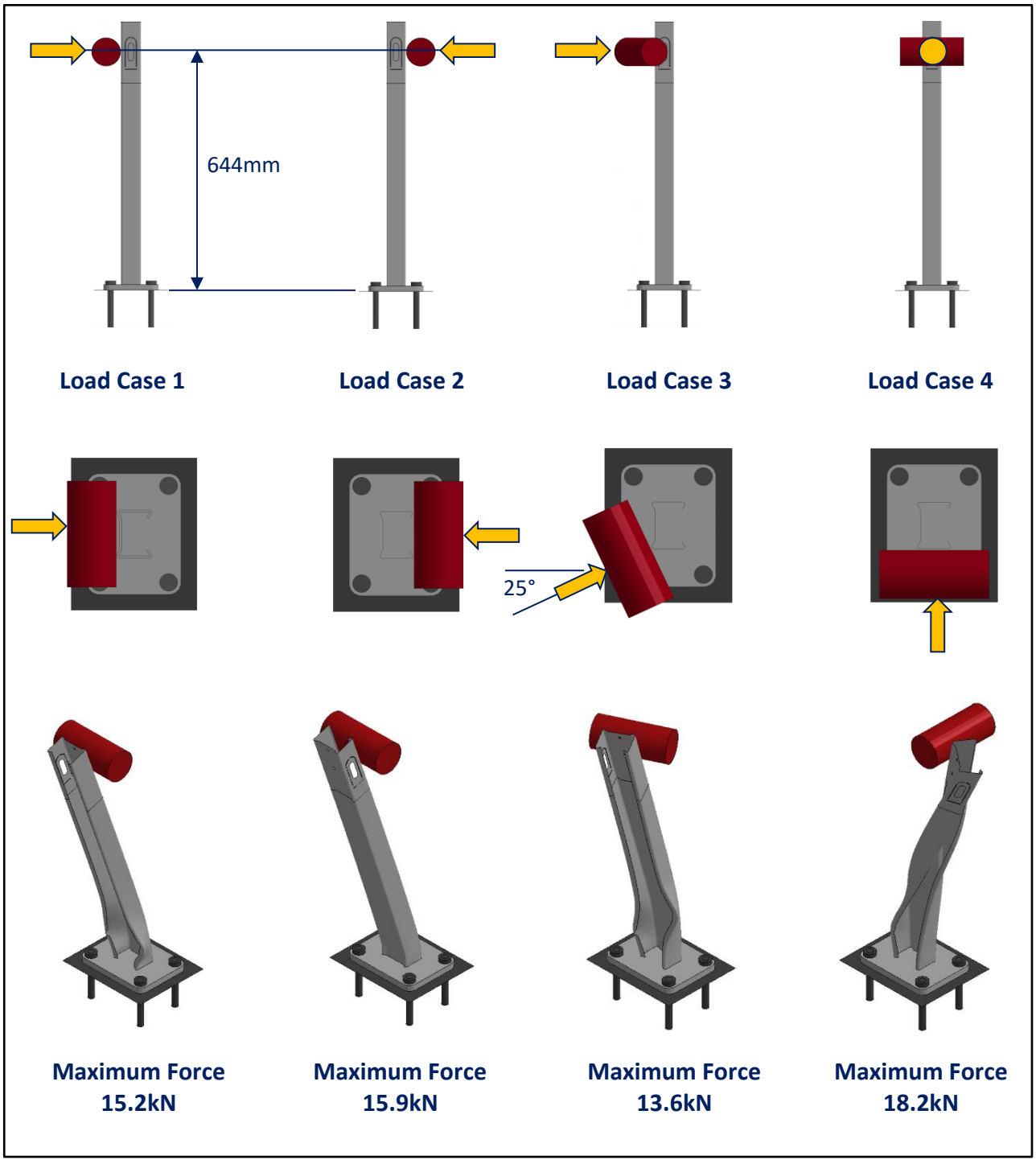
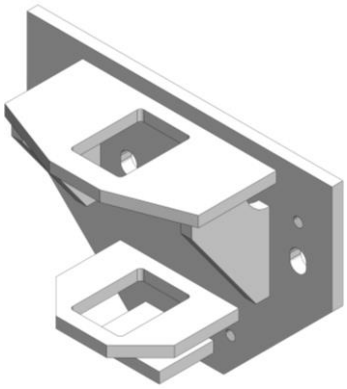
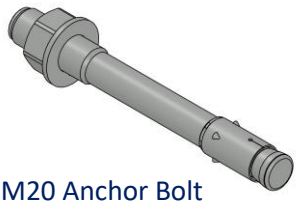


Figure 6: Load Analysis: Baseplate Posts Positioned on a 200mm High Hob

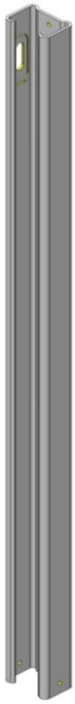
6.0 Component Identification (not to scale)



HammerBeam™
Side Mount Bracket
20kg

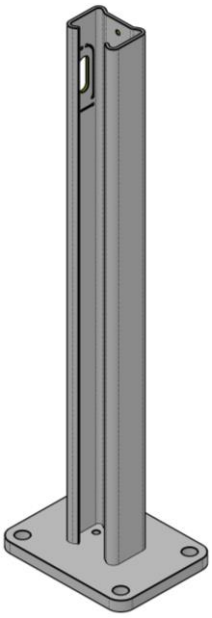


M20 Anchor Bolt



RamShield® Post
(for side mount)
15kg

RamShield® HC Post
(for use with the asymmetric transition)
24kg

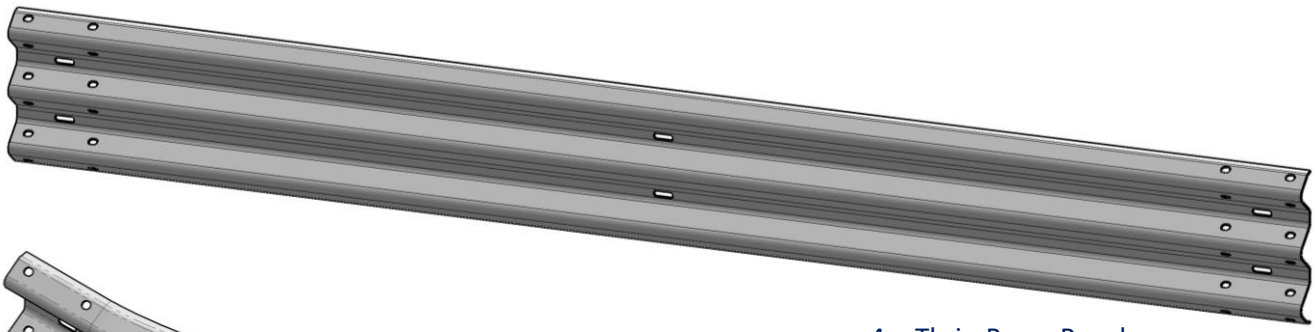


RamShield® Post on
Baseplate
15kg

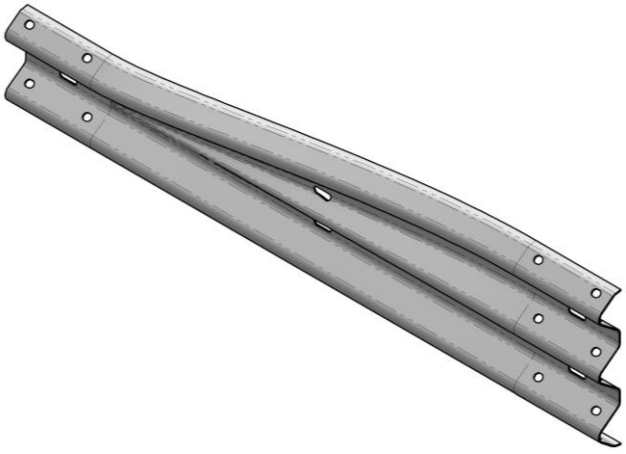
M16x32mm
Mushroom Head Bolt

M16 Oversize Nut

M16 Standard Nut



4m Thrie-Beam Panel
70kg



1.905m Asymmetric Transition
35kg

7.0 Tools Required

Tools required for the installation of HammerBeam™ includes:

- Post driving equipment or auger.
- Air compressor.
- Pneumatic drill driver with 32mm attachment.
- Hand socket with 24mm attachment.
- Metal snips.
- String line.
- Tape measure.
- Hammer.
- 12mm diameter pinch bar.
- Impact drill with a 20mm masonry bit.
- Torque wrench (capacity up to 200Nm).
- Slings or chains.

7.1 Recommended PPE

It is recommended that the following personal protective equipment (PPE) be provided for the safe installation of HammerBeam™:

- Safety footwear.
- Gloves.
- Hearing protection.
- High visibility clothing.
- Sun protection (broad brimmed hat, sunscreen & tinted safety glasses.
- PPE as required for the use of post driving equipment or auger.

8.0 Site Establishment

8.1 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.

8.2 Underground Services

The installation of HammerBeam™ includes drilling into an elevated structure and driving of adjacent posts into the ground. The structure should be inspected for service ducts and adjacent ground material investigated for underground services.

8.3 Overhead Obstructions

The site should be evaluated for potential overhead obstructions that may present a risk during the installation process.

8.4 Fall Protection

The installation of HammerBeam™ along the edge of an elevated structure should consider fall protection for workers. This may include scaffolding or harnesses.

8.5 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.

9.0 Installation Sequence

The major steps in the installation of HammerBeam™ are as follows:

- Set-out.
- Drilling the anchor holes.
- Installing the HammerBeam™ posts.
- Attachment of the thrie-beam guardrails.
- Installing the approach and departure asymmetric transitions.
- Installing the upstream and downstream end terminals.

10.0 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:

- HammerBeam™ does not use offset blocks. The width of the system is just 180mm.
- The standard post spacing of HammerBeam™ is 2.0m.
- The HammerBeam™ system should extend beyond the abutments of the elevated structure.
- The post spacing of the asymmetric transitions is 1.905m.
- The asymmetric transitions should be supported at each end with RamShield® HC posts.
- Upstream and downstream barrier and/or end terminals should be assembled in accordance with proprietor guidelines.

11.0 Anchor Installation

Potential Hazards: *Use of impact drill, contact with reinforcement, excessive noise, hand injury from pinch points and injury from movements and posture.*

Recommended Control Measures: *Maintain balance when drilling, ensure the area has been inspected for service conduits, wear appropriate hearing protection, wear gloves and observe correct techniques when lifting (bend at the knees).*

The attachment of HammerBeam™ to the elevated structure requires drilling of anchor holes. Crash testing was undertaken using M20x187mm Fisher FBN II galvanised anchors.

When applying torque to the Fischer FBN II galvanised anchor, the cone bolt is pulled into the expansion clip forcing it against the side walls of the drilled hole.

Figure 7: M20x187mm Fischer FBN II Anchor.

1. Using a 20mm masonry drill bit (same diameter as the Fischer FBN II galvanised anchor), drill each anchor hole to a minimum depth of 160mm.
2. Using compressed air or a pump, thoroughly clean the hole, removing all loose debris.
3. Position the nut 3mm below the top of the anchor and drive the anchor into the drilled hole to the full embedment depth.
4. Torque the anchor to 200Nm.

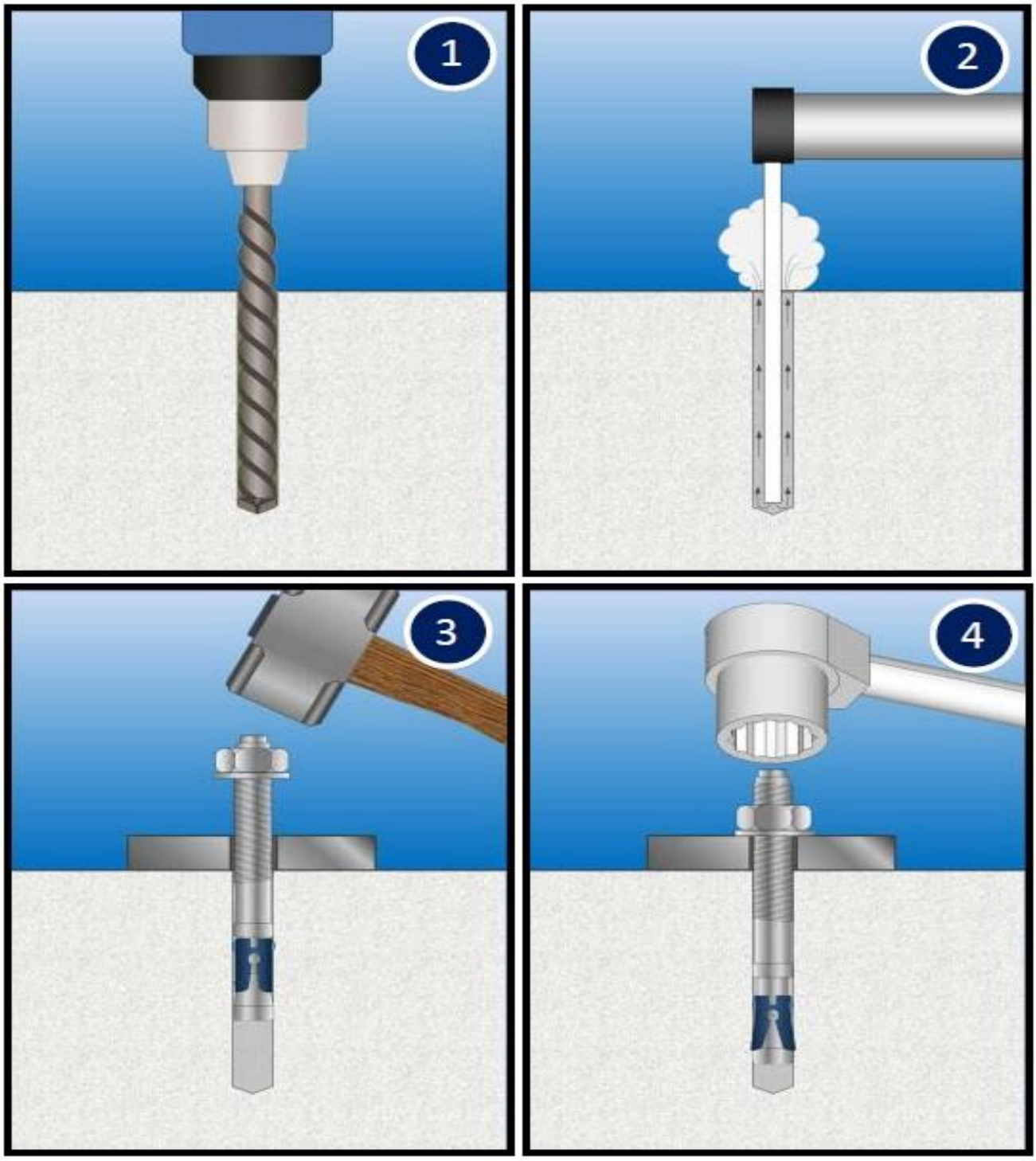


Figure 8: Installation of Fischer FBN II Anchors.

12.0 Post Installation

Potential Hazards: *hand injury from pinch points and injury from movements and posture.*

Recommended Control Measures: *Wear gloves and observe correct techniques when lifting (bend at the knees).*

12.1 Side Mount Posts

Position the side mount bracket against the side wall of the elevated structure and mark-out the anchor hole locations. The bracket may be aligned with the upper edge of the structure but should not protrude above the edge.

Note: The bracket may be positioned up to 50mm below the upper edge of the structure if necessary to avoid conflict with reinforcement.

Drill the anchor holes and secure the bracket with four (4) anchor fixings as described in Section 11.

The HammerBeam™ side mount bracket is manufactured with four (4) M16 threaded holes in the corners allowing the brackets to be vertically levelled (if required).

Place the 1560mm RamShield® post into the post socket and measure the post height from road level. The top of post should be 950mm above top of road level, noting that the thrie-beam rail will be positioned approximately 50mm above the top of the post.

The height of the HammerBeam™ system is always measured from road level regardless of whether a kerb in installed underneath the barrier.

Note: If a kerb is installed, the mounting bracket should not be positioned on the back of kerb unless the kerb forms part of the elevated structure.

Cut the excess post material from the **bottom** of the RamShield® post using a drop saw.

Note: An acetylene torch is not permitted to cut the RamShield® post.

Remove any sharp edges from the bottom of the RamShield® post with a file or grinder and repair the galvanised coating with two (2) coats of a zinc rich paint.

Reposition the RamShield® post within the mounting bracket, ensuring the post is orientated with the release tab positioned on the traffic side of the barrier.

12.2 Baseplate Posts

Position the RamShield® baseplate post along the edge of the elevated structure and mark-out the anchor hole locations. The baseplate should not protrude beyond the edge of the structure.

Drill the anchor holes and secure the post with four (4) anchor fixings as described in Section 11, ensuring the post is orientated with the release tab positioned on the traffic side of the barrier.

Grouting beneath the RamShield® post on baseplate is not required but may be used to level the baseplate, subject to the discretion of the Project Manager.

13.0 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.*

The 4m thrie-beam panels are secured to each RamShield® posts using one (1) M16 x 32mm mushroom head bolt with a standard nut. The bolts passes through the upper slot in the thrie-beam rail.

The standard nut is tightened using a hand socket and 24mm attachment.

The thrie-beam guardrail 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 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.

Note: 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 RamShield® posts, the finishing height of the thrie-beam guardrail will be approximately 50mm above the top of the posts.

14.0 Installing the Transitions

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).*

Asymmetric transitions, measuring 1.905m, are used to transition from thrie-beam to w-beam facilitating connection to end terminals or continuation of upstream and downstream barrier.

The asymmetric transitions are supported at each end using RamShield® High Containment (HC) posts.

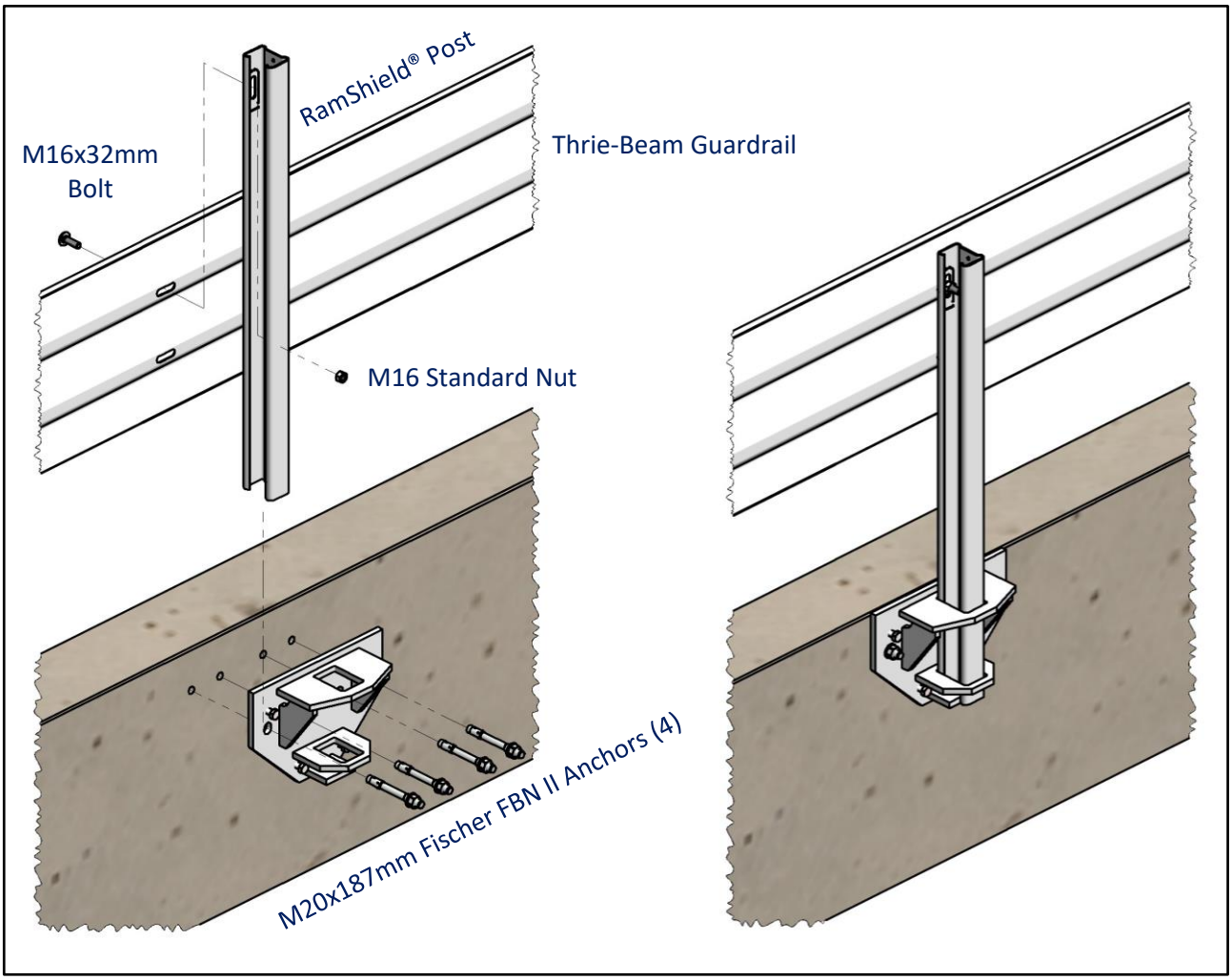
The RamShield® HC posts may be installed by:

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

Note: The asymmetric transitions are supplied as an approach or departure configuration as shown in Figures 10 & 12.

The asymmetric transitions are secured to each RamShield® HC post using one (1) M16 x 50mm mushroom head bolt with an oversize nut.

The transition rail lap is orientated so that the leading edge of the splice is shielded from the nearside approaching traffic. The transition rails are spliced to the thrie-beam rails using twelve (12) standard M16 x 32mm mushroom head bolts and oversize nuts and tightened as described in Section 13.0.



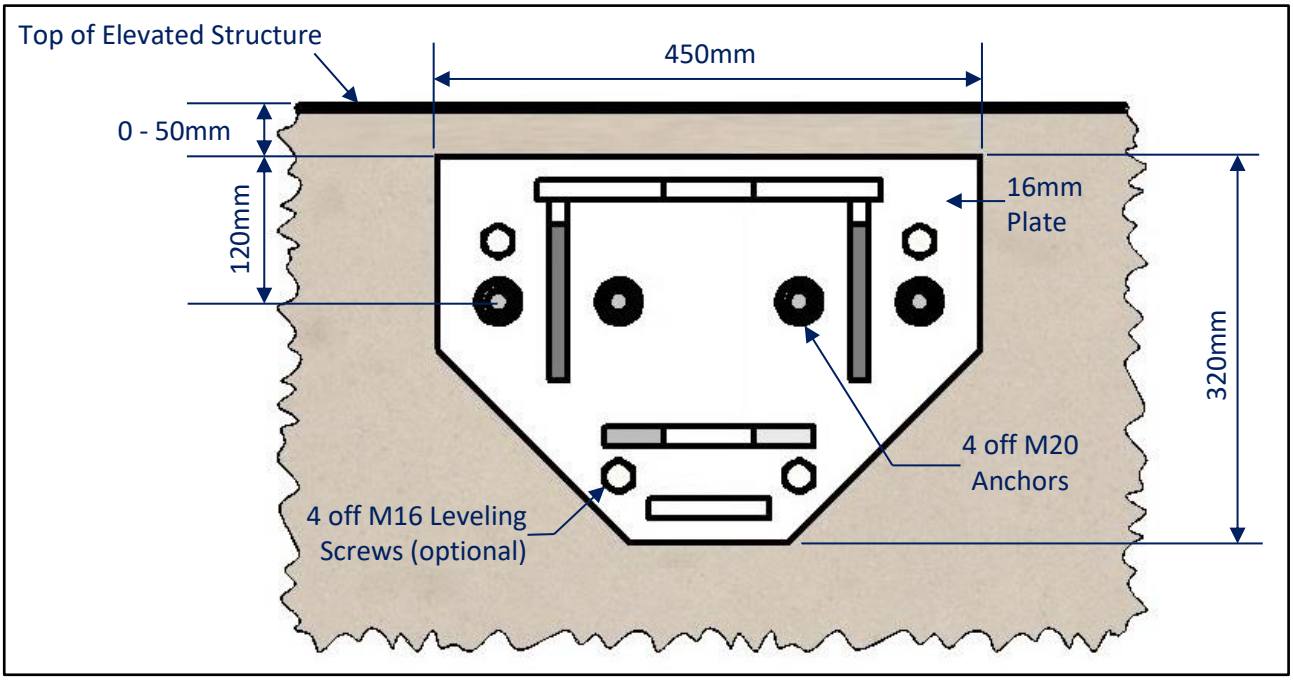
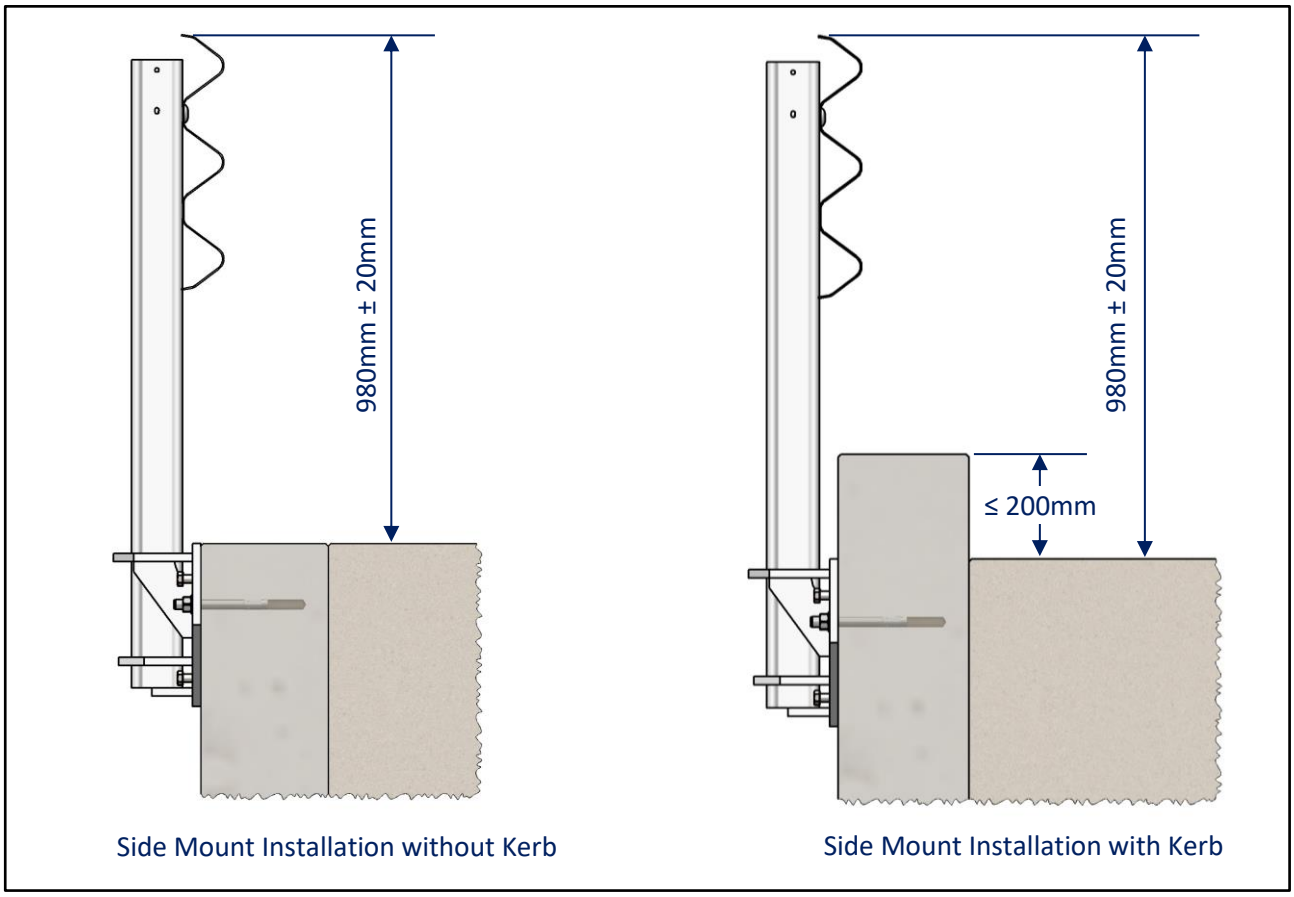


Figure 9: HammerBeam™ Side Post Mounting Bracket.



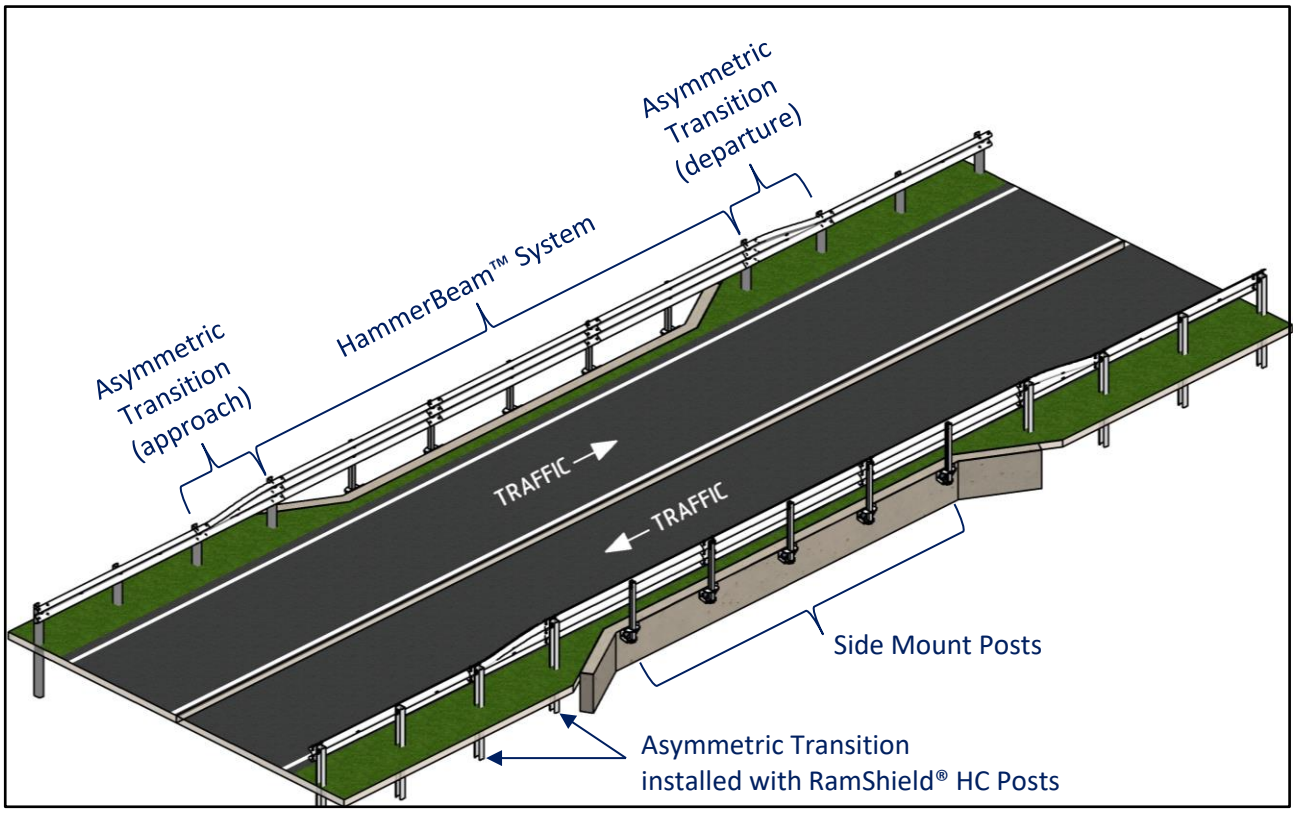
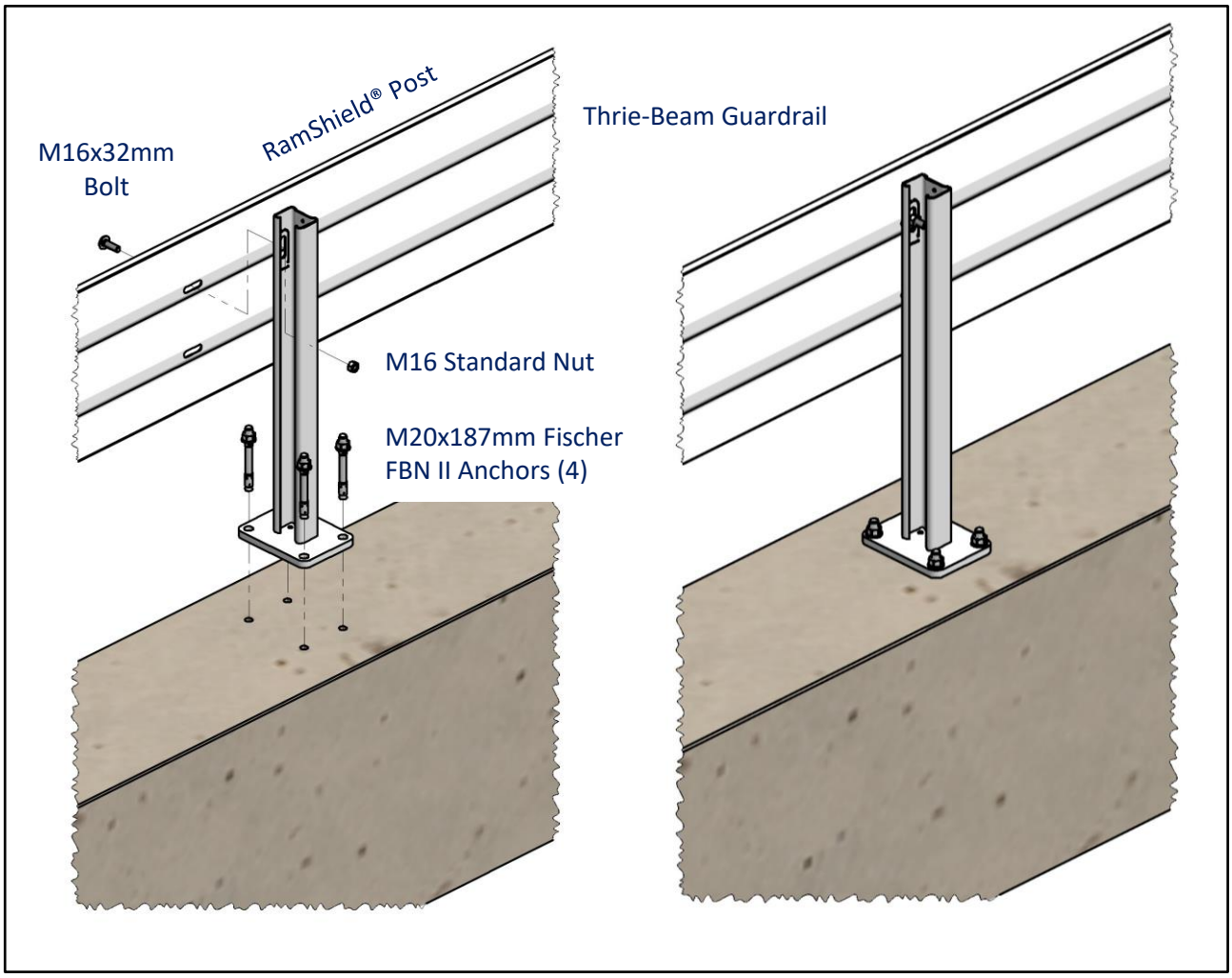


Figure 10: HammerBeam™ Side Post Mounting Assembly.



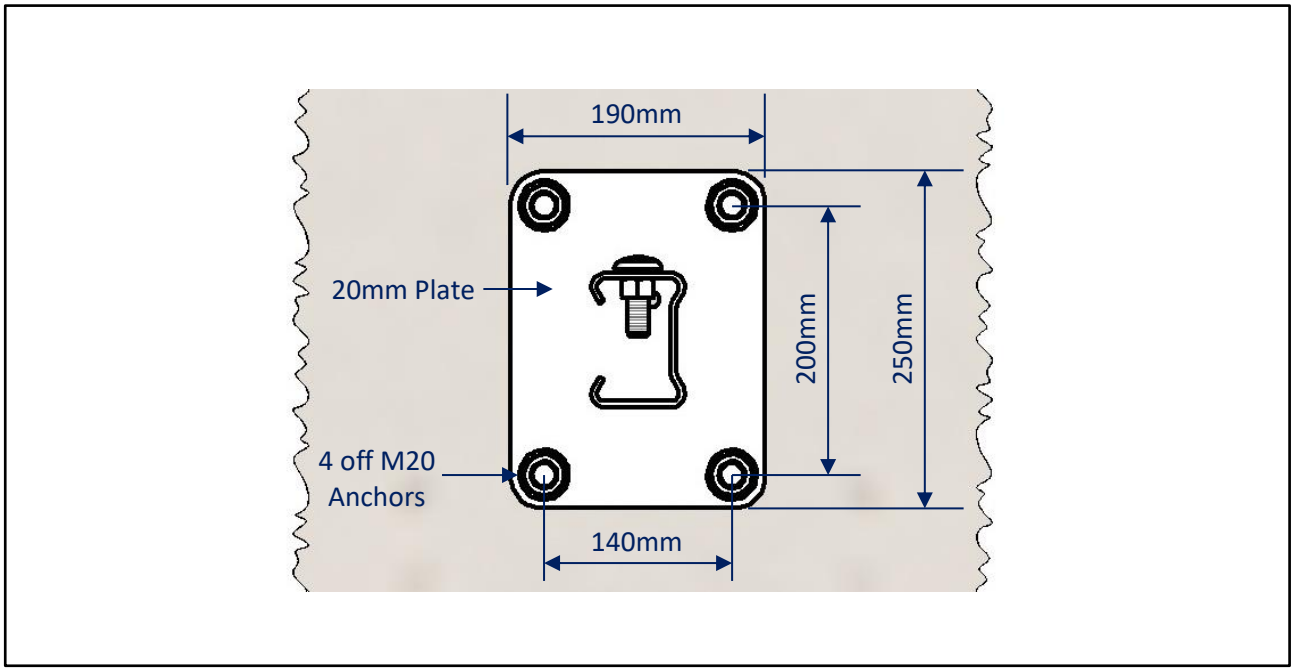
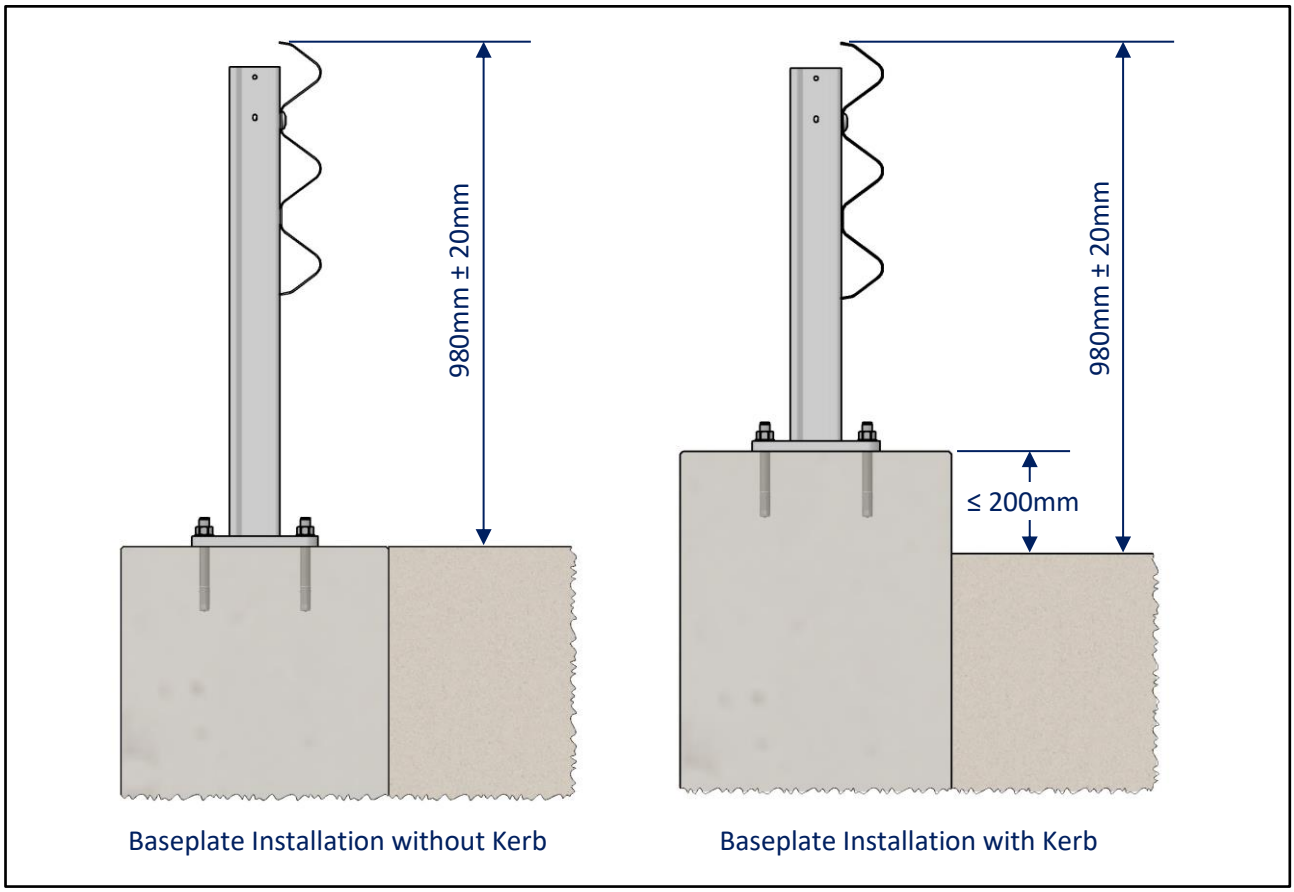


Figure 11: HammerBeam™ Baseplate Post.



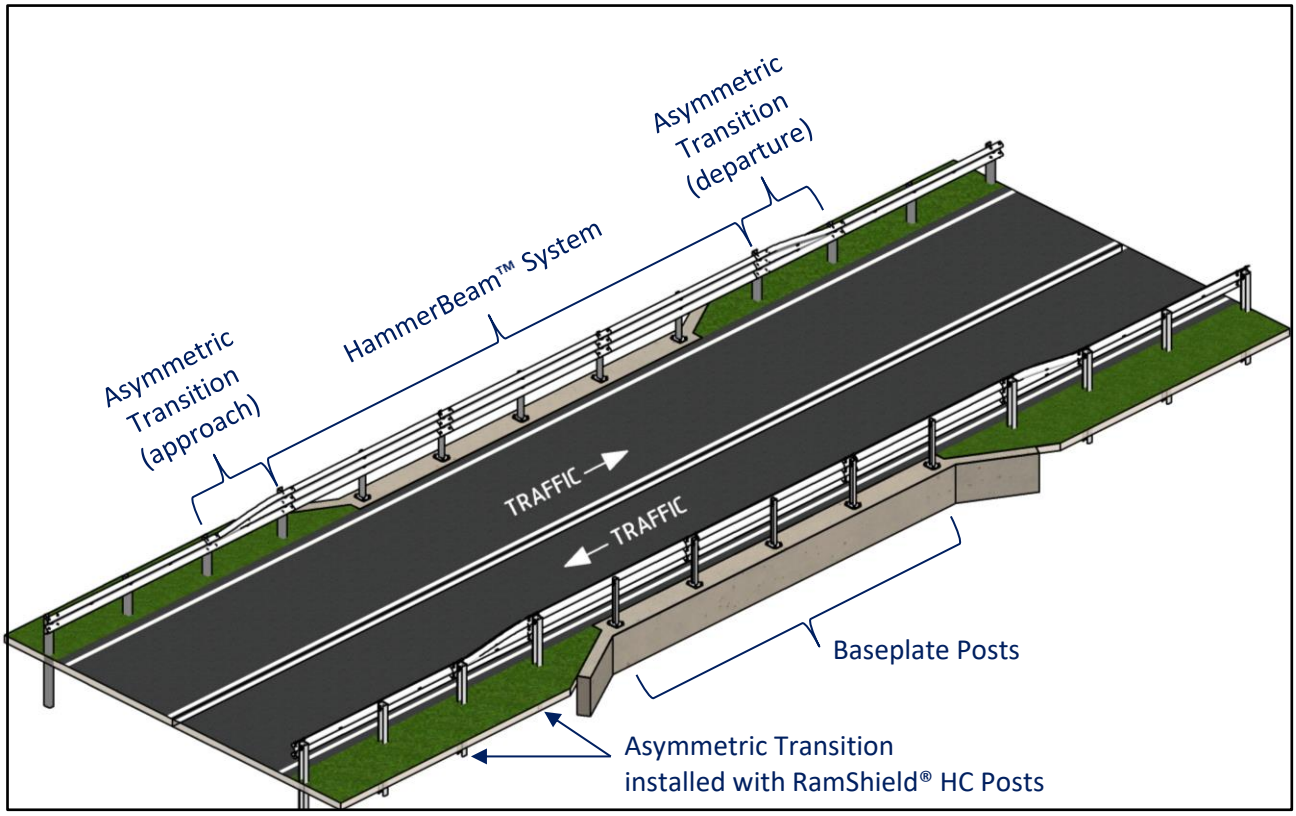


Figure 12: HammerBeam™ Baseplate Posts Assembly.

HammerBeam™ 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	The posts are spaced at maximum 2.0m centres.
❑ Yes ❑ No	The posts are correctly orientated with the release tab on the traffic side.
❑ Yes ❑ No	Each post or mounting bracket is secured with four (4) M20 x 187mm Fischer FBN II galvanised anchors, embedded to a minimum depth of 160mm.
❑ Yes ❑ No	Each anchor is torqued to 200Nm.
❑ Yes ❑ No	The thrie-beam rail is secured to each post with a M16 x 32mm mushroom head bolt & standard nut.
❑ Yes ❑ No	The height measured to the top of the thrie-beam rails is 980mm ± 20mm.
❑ Yes ❑ No	The rails are 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 bolts are tightened.
❑ Yes ❑ No	The asymmetric transitions are installed with RamShield® HC posts at each end.
❑ Yes ❑ No	Any minor damage to the galvanised finish of the posts is repaired using two coats of an organic zinc rich paint.
❑ Yes ❑ No	The area around the barrier is free of debris.

Comments/Notes

15.0 Maintenance

HammerBeam™ 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.
- The anchor assembly at the end terminals is taut and the bearing plate is correctly aligned.

16.0 Repair

In the event of a vehicle impact, damage to the barrier is to be assessed in accordance with Table 1. Typically, impacts with HammerBeam™ 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.

Brackets used for the side-mount posts should also be inspected for deformation and damage to the galvanised coating as described in Table 1.

Additional tools required for repair include:

- Acetylene torch to cut away damaged rail.
- Grinder to cut away damaged side mount posts.
- Heavy duty chain to remove damaged posts.
- Sledgehammer.

Similar to the installation sequence, it is recommended that the guidelines contained in Section 8.0 be observed in the establishment of traffic control and an unloading exclusion zone in addition to investigation for services and overhead obstructions.

16.1 Removal of Damaged Posts

Potential Hazards: *Hand injury from pinch points, hand injury from damaged edges.*

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

Damaged baseplate posts are removed by removing the anchor bolt nut. As the replacement post is positioned the anchors may need to be hammered to the required depth. Ensure the anchor bolts are re-torqued. The torque of anchors on upstream and downstream posts should be rechecked.

Damaged side mount posts may need to be cut away with a grinder. Before positioning the replacement post within the mounting bracket, the anchor bolts may need to be hammered to the required depth. Ensure the anchor bolts are re-torqued. The torque of the anchors of upstream and downstream brackets should be rechecked.

16.2 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 1: Damage Assessment Guidelines.

Type of Damage	Description of the Damage	Remedial Action
Damage to the galvanised coating on the RamShield® posts.	The sum total of the damaged area does not exceed 40cm^2 (0.5% of the total surface area).	An organic zinc rich paint is to be applied to the repair area in two coats.
	The sum total of the damaged area exceeds 40cm^2 (0.5% of the total surface area).	The post is to be replaced.
Damage to the galvanised coating on the thrie-beam rails.	The sum total of the damaged area does not exceed 250cm^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 250cm^2 (0.5% of the total surface area) or an individual damaged area exceeds 40cm^2.	The rail is to be replaced.
Damage to the galvanised coating on the mounting brackets.	The sum total of the damaged area does not exceed 23cm^2 (0.5% of the total surface area).	An organic zinc rich paint is to be applied to the repair area in two coats.
	The sum total of the damaged area exceeds 23cm^2 (0.5% of the total surface area).	The bracket is to be replaced.
Damage to the RamShield® posts.	The post is bent.	The post is to be replaced.
Damage to the RamShield® post tab.	The post tab has pulled forward by breaking the top connection and/or there is tearing evident in either of the two bottom connections.	The post is to be replaced.
	The post tab has become detached from the post.	
Damage to the thrie-beam 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 the mounting brackets.	The bracket is bent or distorted	The bracket is to be replaced.
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 inground posts.	The material around a post is loose.	The material is to be suitably compacted.

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