RhinoStop®

Car Park & Industrial Crash Barriers

SafeDirection
CRASH BARRIER SOLUTIONS

safedirection.com.au

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Leading Safety

Compliance to AS/NZS 1170.1 Structural Design Actions (Clause 3.8)

Full scale crash tested to validate performance

Impact conditions designed to exceed those nominated by the Standard

Crash testing performed on the edge of thin elevated slabs

Available with pedestrian fall protection

Energy Absorbing

Yielding base plate reduces the potential for damage to the concrete slab

Controlled absorption of vehicle impact energy

Lower anchor bolt forces

Architectural Solutions

Aesthetic design options

High cross flow ventilation

Fast Assembly

Fully modular systems

Fewer anchor bolts per post

Durable

Galvanised components

Local Support

Designed by Safe Direction for Australian and New Zealand Standards

1.0 Introduction

Car park barriers are a specific range of safety barrier systems designed for the protection of people, buildings, plant and equipment. Their design and function are specific to vehicle movements encountered in a car park or warehouse/industrial environment.

Designers of car park and industrial barriers should consider the following:

- The barriers should be capable of withstanding impact loads in accordance with relevant Australian standards and building codes,
- Impacts are likely to be perpendicular to the barrier i.e. 90 degrees,
- Pedestrian walkways or thoroughfares adjacent to the barrier,
- Channelling of people or restriction of access,
- Falls or a drop to a lower level behind the barrier,
- Available space for a barrier system, and
- Impact damage should be confined to the barrier system and not the car park structure.

The Australian-designed range of RhinoStop® crash barriers has been developed specifically for carpark, warehouse and industrial applications. The yielding behaviour of the RhinoStop® baseplate absorbs vehicle impact energy, reducing the peak loads transferred to the anchor bolts. The deflection of the system allows for greater load transfer to the adjacent posts, sharing the impact load from the vehicle.

Featuring all-steel designs, RhinoStop® is recognised as the industry leader in modular safety barrier systems and is regularly specified for installation in multi-story carparks, manufacturing facilities, logistics warehouses and other areas that require to withstand a vehicle collision.

For multi-storey carpark barrier applications, RhinoStop® has been crash tested along the edge of a thin elevated slab, demonstrating safe vehicle containment while preventing damage to the slab. RhinoStop® guard railing can also be configured to provide pedestrian fall protection, providing an economical solution and a narrow footprint.

In warehouse and industrial applications, RhinoStop® products create a safer work environment by separating pedestrians, machinery, heavy vehicles and forklifts. W-beam guardrails may be powder coated yellow, enhancing visibility to shield pallet racking, delineate pathways or protect valuable plant and equipment. RhinoStop® may be configured with a single or double height w-beam guardrail providing a tailored design dependant on specific site requirements.

2.0 How RhinoStop® Works

RhinoStop® posts are significantly stronger than similarly sized and anchored rigid posts. All RhinoStop® barriers incorporate a unique patented yielding base plate that minimises the peak loads transferred to the anchor bolts.

The defining feature of the RhinoStop® posts are the long cuts in the base plate breaking the plate into three fingers connected by a common stem. Upon impact from a vehicle, a plastic hinge will form as the post begins to rotate backwards. This deformation serves two primary functions:

1. The load capacity of the plastic hinge is designed to be less than the pull-out capacity of the anchor bolt, and

2. The deflection of the system allows for greater load transfer to adjacent posts thereby sharing the impact load from the vehicle.

Figure 1: Yielding behaviour of RhinoStop® baseplate.

3.0 Risk of Rigid Post Systems

The vulnerability of rigid post systems is the high peak load transferred to the anchors upon vehicle impact. This can cause anchor failure, resulting in damage to the concrete substrate. Damage to the concrete substrate is difficult to repair and may compromise the structural integrity of the car park structure.

Figure 2: Impact behaviour of rigid post systems.

4.0 Standards & Guidelines

4.1 AS/NZS 2890.1 Parking Facilities

AS/NZS 2890.1 sets out the minimum requirements for the design and layout for off-street parking facilities, including multi-storey car parks.

Barriers shall be constructed to prevent vehicles from running over the edge of a raised platform or deck of a multi-storey car park including the perimeter of all decks above ground level. They are required wherever the drop from the edge of the deck to a lower level exceeds 600mm.

AS/NZS 2890.1 states that barriers shall comply with the following requirements:

a) They shall be designed structurally for the loading requirements of AS/NZS 1170.1,

b) If at the end of a parking space, they shall be at least 1.3m high so that drivers backing into the space can see the barrier above the rear of the vehicle, and

c) They shall not be made from brickwork, unreinforced concrete or other materials likely to shatter on impact.

4.2 Building Code of Australia

A 1m high continuous barrier (balustrade) must be provided along the side of a floor if the trafficable surface is 1m or more above the surface beneath.

Openings in the barrier must not allow a 125mm sphere to pass through any opening.

If the drop to a lower level exceeds 4m, any horizontal elements between 150mm and 760mm above the floor must not facilitate climbing.

The barrier must be of strength and rigidity to withstand the foreseeable impact of people and where appropriate, the static pressure of people pressing against it.

4.3 AS/NZS 1170.1 Structural Design Actions, Part 1 (Clause 3.8)

The horizontal imposed action on barriers required to withstand the accidental impact from vehicles during parking shall be taken as follows:

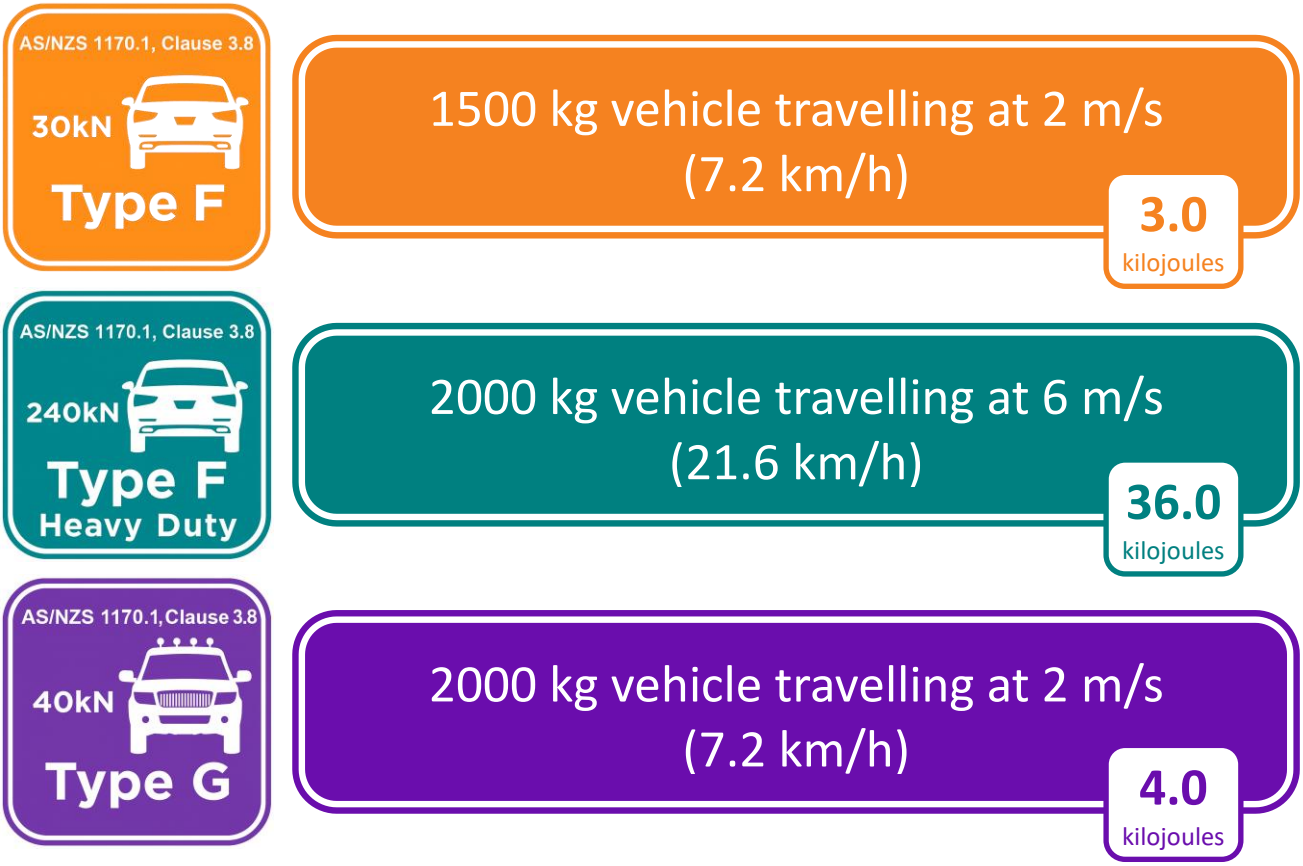
a) For light traffic areas (Type F)

   i. Barriers – 30kN

   ii. Barriers at the end of straight ramps exceeding 20m in length and intended for downward travel – 240kN

b) For barriers in medium traffic areas (Type G) – 40kN

The impact force shall be distributed over a 1.5m length at any position along the barrier and shall be assumed to act 0.5m above floor level for light traffic areas and at 1.0m for medium traffic areas.



5.0 RhinoStop® Crash Test Evaluation

Full-scale crash testing of each RhinoStop® system evaluates the impact performance of the system, capacity of the anchors, potential damage to the concrete slab and post-impact vehicle behaviour.

The underlying philosophy when undertaking full-scale crash testing should be 'worst practical conditions.' When selecting the test parameters, such as the test vehicle, impact speed and barrier configuration, every effort should be made to assess the worst, or most critical, conditions.

Therefore, Safe Direction has adopted the following criteria when evaluating RhinoStop® systems:

- The posts are installed on the edge of 150mm thick, suspended concrete slabs. This configuration thoroughly evaluates the potential for concrete edge failure and the suitability of anchor embedment depths,
- Vehicle impacts are performed at up to twice the speed nominated by the Standard,
- Short-length barrier systems, designed to distribute the impact load on fewer posts and produce the largest system deflection, and
- Impacts performed at the end of the barrier system to maximise loading on the end post.

Figure 3: Crash testing of RhinoStop® Standard

6.0 RhinoStop® Standard

RhinoStop® Standard combines the strength of w-beam guardrail with energy absorbing posts. The yielding behaviour of the RhinoStop® baseplate absorbs vehicle impact energy, reducing the peak loads transferred to the anchor bolts and preventing damage to the concrete slab.

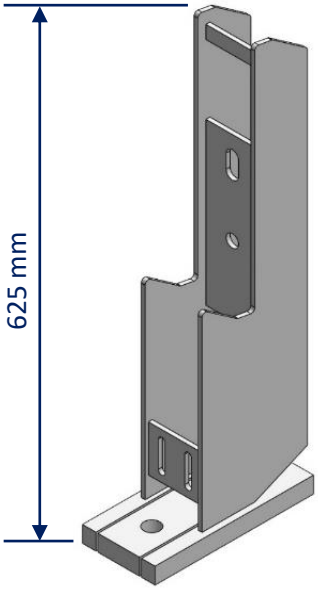
6.1 Crash Test Performance

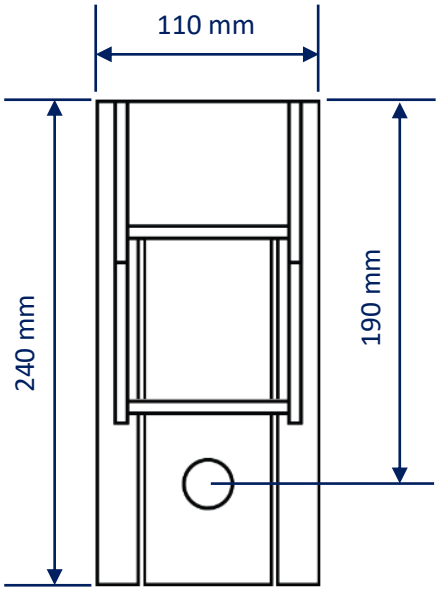
Vehicle Type	Impact Speed	Impact Height	Impact Energy	Barrier Configuration
1500 kg	15 km/h	0.5m	12.9 kilojoules	4 m w-beam supported by three (3) posts at 2.0 m centres positioned on the outside edge of a 150 mm elevated concrete slab.

6.2 Installation Requirements

Anchor Type	Drill Depth	Torque	Anchors per Post	Minimum Concrete Slab Thickness
M20 Fischer FBN II	115 mm	200 Nm	1 off	150 mm

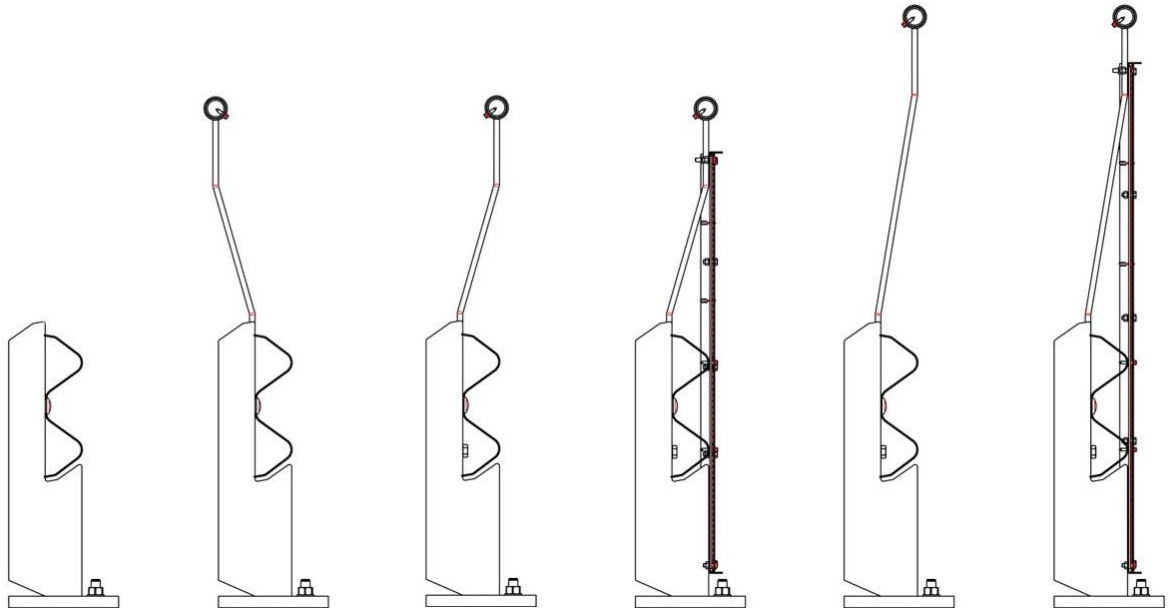
6.3 Post & Baseplate Detail





AS/NZS 1170.1, Clause 3.8
30kN
Type F

6.4 Installation Variants



Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Guardrail only 610mm high	Guardrail with offside handrail 1100mm high	Guardrail with nearside handrail 1100mm high	Guardrail with handrail & mesh 1100mm high	Guardrail with sight rail 1300mm high	Guardrail with sight rail & mesh 1300mm high

7.0 RhinoStop® SkyEdge

The unique design of RhinoStop® SkyEdge positions the crash barrier on the outer edge of the carpark deck. The alignment of the w-beam guardrail with the edge of the deck ensures the barrier does not encroach into valuable space allocated for car parking. RhinoStop® SkyEdge has become the preferred solution for upgrading existing carparks that have limited floor space and cannot accommodate the additional width of a safety barrier system.

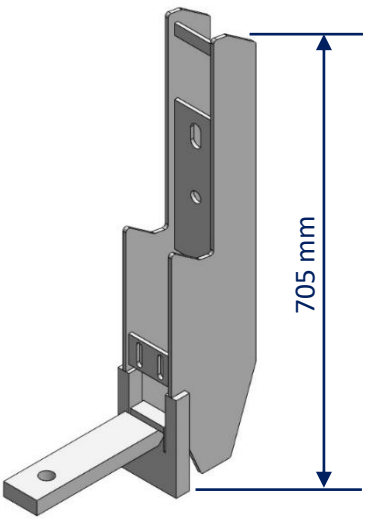
7.1 Crash Test Performance

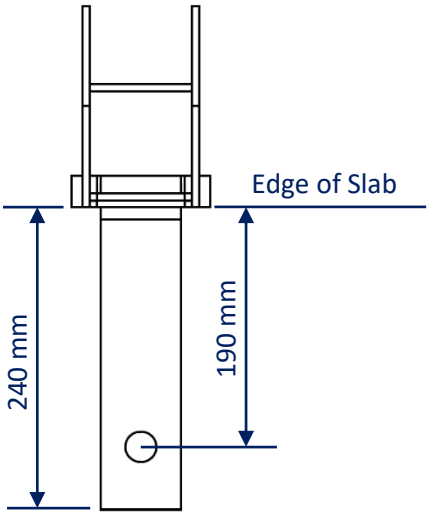
Vehicle Type	Impact Speed	Impact Height	Impact Energy	Barrier Configuration
1500 kg	15 km/h	0.5m	12.9 kilojoules	4 m w-beam supported by three (3) posts at 2.0 m centres positioned on the outside edge of a 150 mm elevated concrete slab.

7.2 Installation Requirements

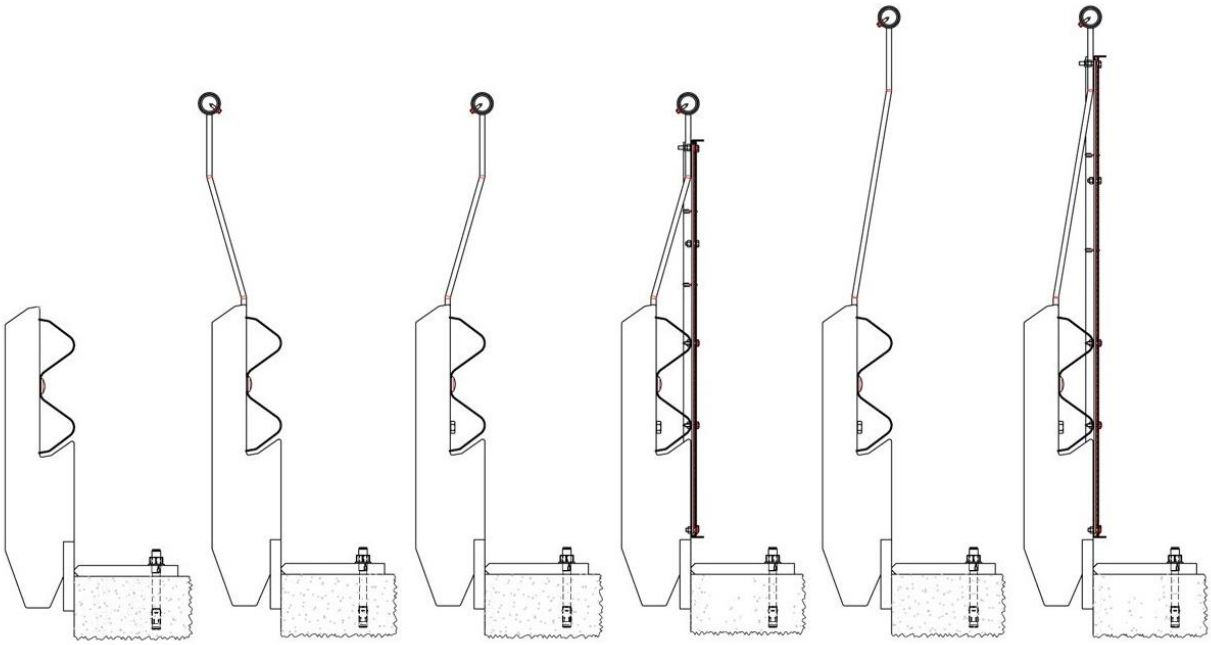
Anchor Type	Drill Depth	Torque	Anchors per Post	Minimum Concrete Slab Thickness
M20 Fischer FBN II	115 mm	200 Nm	1 off	150 mm

7.3 Post & Baseplate Detail





7.4 Installation Variants



Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Guardrail only 610mm high	Guardrail with offside handrail 1100mm high	Guardrail with nearside handrail 1100mm high	Guardrail with handrail & mesh 1100mm high	Guardrail with sight rail 1300mm high	Guardrail with sight rail & mesh 1300mm high

8.0 RhinoStop® Heavy Duty

RhinoStop® Heavy Duty is designed to withstand high speed impacts typically encountered at the ends of ramps and straight aisles in car parking areas. These areas are prone to vehicle speeds up to 30km/h and therefore require a barrier system with increased capacity.

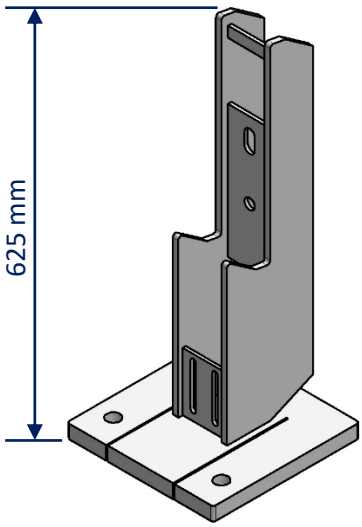
8.1 Crash Test Performance

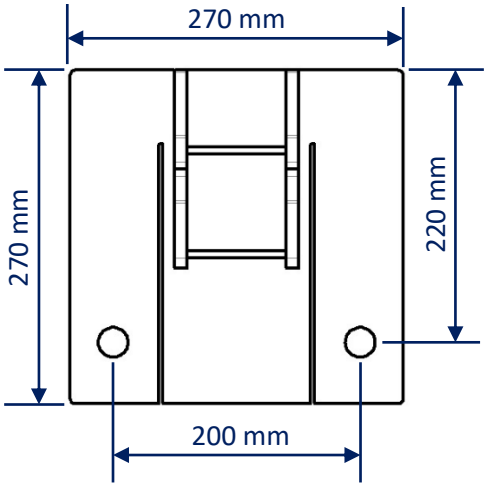
Vehicle Type	Impact Speed	Impact Height	Impact Energy	Barrier Configuration
2000 kg	30 km/h	0.5 m	67.2 kilojoules	4 m w-beam supported by six (6) posts at 0.8 m centres positioned on the outside edge of a 150 mm elevated concrete slab.

8.2 Installation Requirements

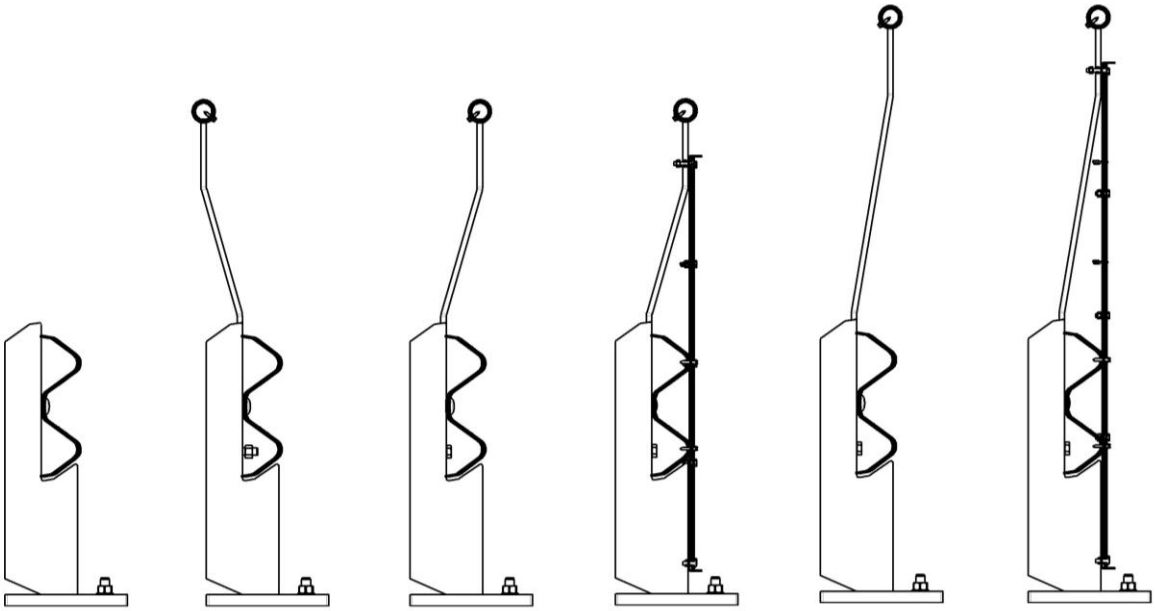
Anchor Type	Drill Depth	Torque	Anchors per Post	Minimum Concrete Slab Thickness
M20 Fischer FBN II	115 mm	200 Nm	2 off	150 mm

8.3 Post & Baseplate Detail





8.4 Installation Variants



Type 1
Guardrail only
610mm high

Type 2
Guardrail with
offside handrail
1100mm high

Type 3
Guardrail with
nearside handrail
1100mm high

Type 4
Guardrail with
handrail & mesh
1100mm high

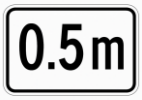
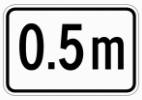
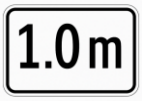
Type 5
Guardrail with
sight rail
1300mm high

Type 6
Guardrail with
sight rail & mesh
1300mm high

9.0 RhinoStop® TruckGuard

RhinoStop® TruckGuard features double height w-beam guardrails supported by heavy duty posts designed to withstand impacts from high-centre-of-gravity vehicles. The 1m system height improves visibility for truck drivers and forklift operators making it the preferred barrier solution for loading docks, transport logistic warehouses and carparks frequented by heavy vehicles.

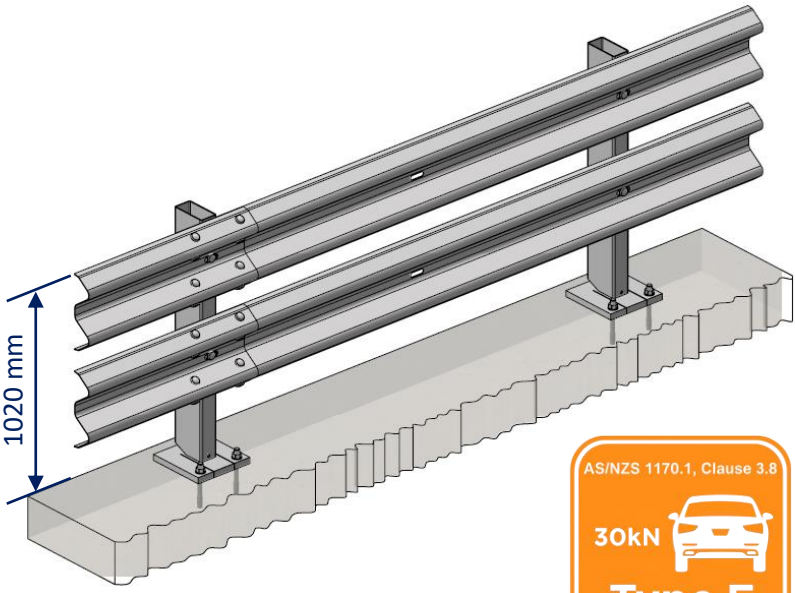
9.1 Crash Test Performance

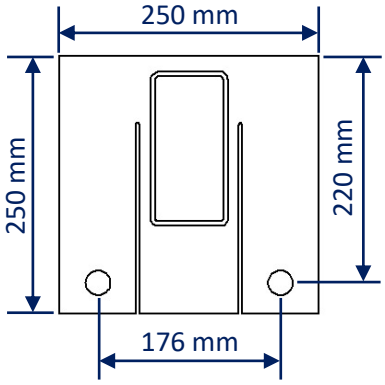
Vehicle Type	Impact Speed	Impact Height	Impact Energy	Barrier Configuration
				4 m double-height w-beam supported by five (5) posts at 1.0 m centres secured to a 150 mm thick concrete slab.
				6 m double-height w-beam supported by four (4) posts at 2.0 m centres secured to a 150 mm thick concrete slab.
				8 m double-height w-beam supported by five (5) posts at 2.0 m centres secured to a concrete slab.

9.2 Installation Requirements

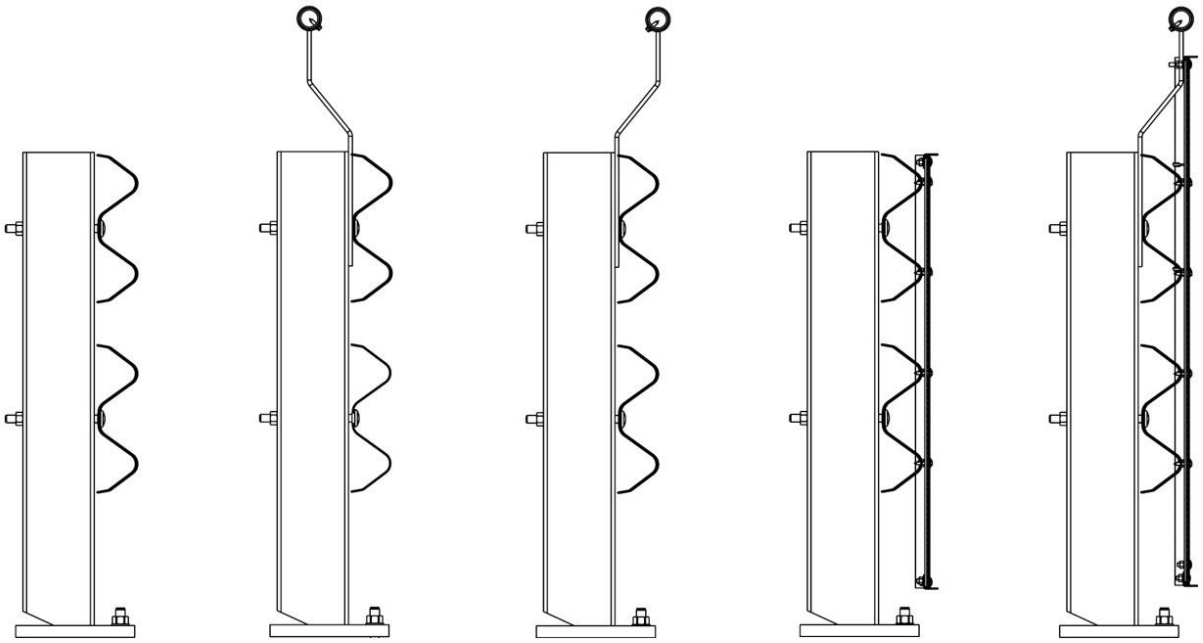
Anchor Type	Drill Depth	Torque	Anchors per Post	Minimum Concrete Slab Thickness
M20 Fischer FBN II	115 mm	200 Nm	2 off	150 mm

9.3 System & Baseplate Detail





9.4 Installation Variants



Type 1
Guardrail only
1020mm high

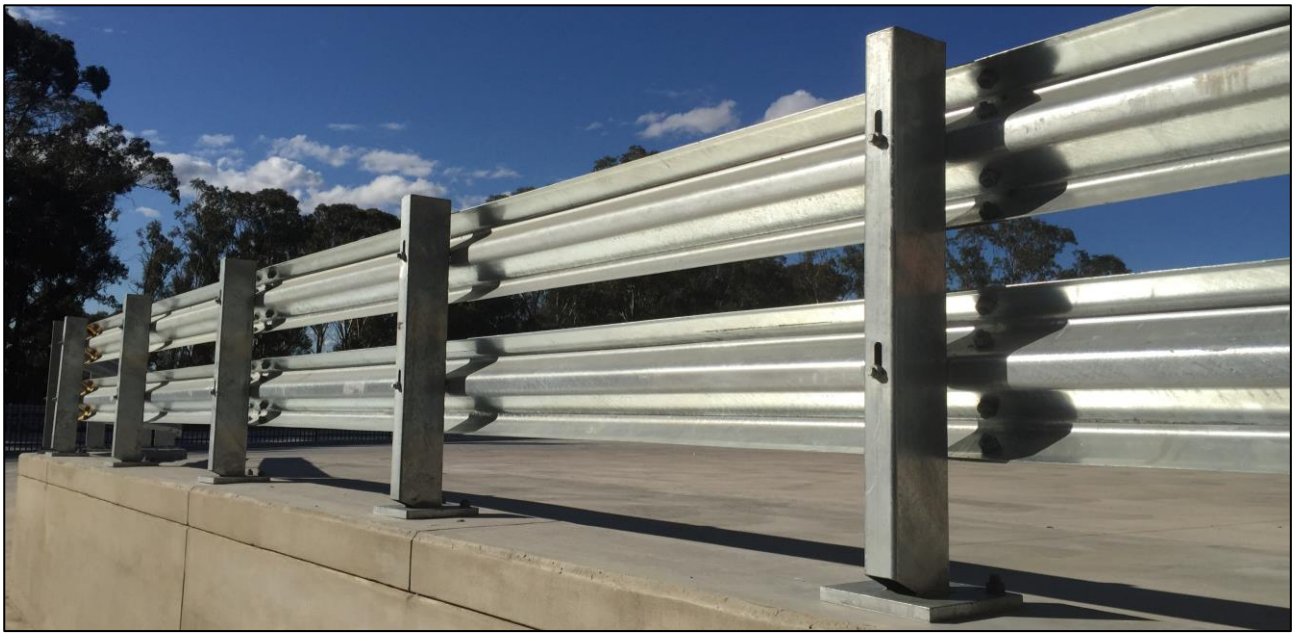
Type 2
Guardrail with
offside handrail
1300mm high

Type 3
Guardrail with
nearside handrail
1300mm high

Type 4
Guardrail with
mesh
1020mm high

Type 5
Guardrail with
handrail & mesh
1300mm high


RHINO STOP
TRUCK GUARD

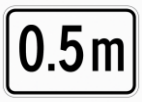
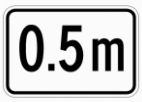
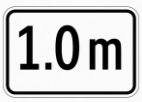


10.0 RhinoStop® Elite

RhinoStop® Elite is the benchmark in modular carpark safety barriers combining vehicle impact containment with pedestrian fall protection. The aesthetic design of RhinoStop® Elite provides high cross flow ventilation, permits natural light into the carpark structure and may be powder coated providing architectural excellence.

The 1100mm system height demonstrates containment of vehicles with varying bumper heights, an important design consideration for the Australian vehicle fleet and the growing ownership of high-centre-of-gravity SUV vehicles.

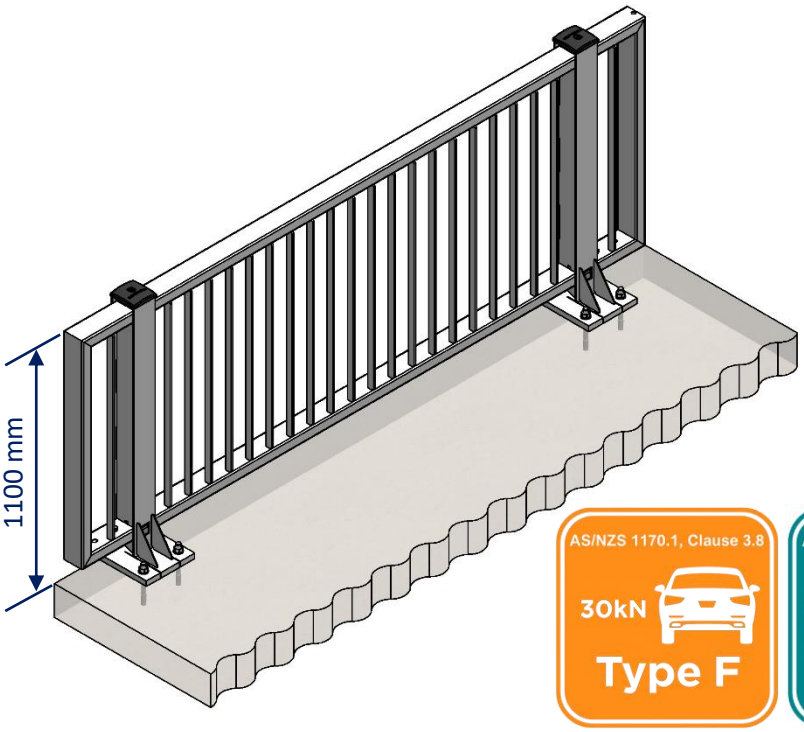
10.1 Crash Test Performance

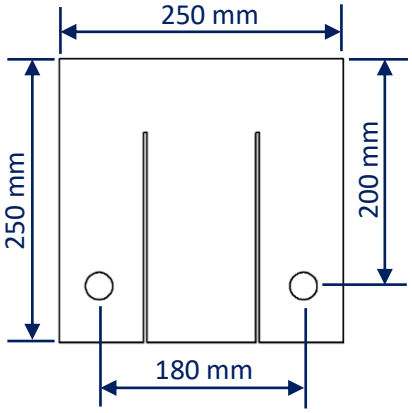
Vehicle Type	Impact Speed	Impact Height	Impact Energy	Barrier Configuration
				One (1) panel supported by two (2) posts at 2.3 m centres positioned on the outside edge of a 150 mm thick elevated concrete slab.
				Three (3) panels supported by four (4) posts at 2. 3m centres positioned on the outside edge of a 150 mm thick elevated concrete slab.
				Two (2) panels supported by three (3) posts at 2.3 m centres positioned on the outside edge of a 150 mm thick elevated concrete slab.

10.2 Installation Requirements

Anchor Type	Drill Depth	Torque	Anchors per Post	Minimum Concrete Slab Thickness
M20 Fischer FBN II	115 mm	200 Nm	2 off	150 mm

10.3 System & Baseplate Detail





11.0 Installation

11.1 Tools Required

Tools required for the installation of RhinoStop® includes:

- Impact drill with 20mm masonry bit,
- Rattle gun or wrench with 24mm and 32mm socket,
- Torque wrench (capacity up to 200Nm),
- Drop saw,
- Driver, small socket set and step drill bit,
- Grinder with metal cutting disk,
- Hammer,
- 12mm Pinch bar,
- Metal snips,
- String line,
- Tape measure, and
- Slings or chains.

11.2 Recommended PPE

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

- Safety footwear,
- Gloves,
- Hearing protection,
- High visibility clothing, and
- Sun protection (broad brimmed hat, sunscreen & tinted safety glasses).

11.3 Traffic Control

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

11.4 Below Ground Obstructions

The installation of the RhinoStop® requires drilling of holes into a concrete slab. Prior to the installation of posts an investigation for potential underground hazards such as post tensioned cables, rebar, service conduits or electrical cables should be undertaken. These hazards should be clearly identified prior to set-out of the barrier.

11.5 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 moves 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.

11.6 Concrete Curing

When installing RhinoStop® barriers onto a recently poured concrete substrate, the concrete must be fully cured prior to the installation of the anchor bolts. Curing time can vary from site to site and is to be advised by the site construction manager.

11.7 Concrete Thickness

Crash testing of RhinoStop® barriers has been undertaken on a 150mm thick, 32MPa, reinforced, elevated concrete slab. Please contact Safe Direction when thinner slabs are encountered.

11.8 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:

- Locate and identify any below-ground obstructions,
- Post spacings are not to exceed the maximum (refer to Crash Test Performance of each RhinoStop® barrier),
- Each installation comprises the minimum number of posts (refer to Crash Test Performance of each RhinoStop® barrier),
- The back of the base plate must not extend beyond the edge of the concrete slab (not applicable to RhinoStop® SkyEdge), and
- If there is a fixed hazard behind the barrier, sufficient clearance behind the post is required to allow for the deflection of the system (contact Safe Direction for guidelines).

11.9 Anchor Installation

Please refer to specific RhinoStop® system types for guidelines on number of anchors required per post.

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

1. Using a 20mm masonry drill bit (same diameter as the Fischer FBN II galvanised anchor), drill the anchor hole to the depth nominated for each RhinoStop® system.

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 depth.

4. Torque the anchor as required.

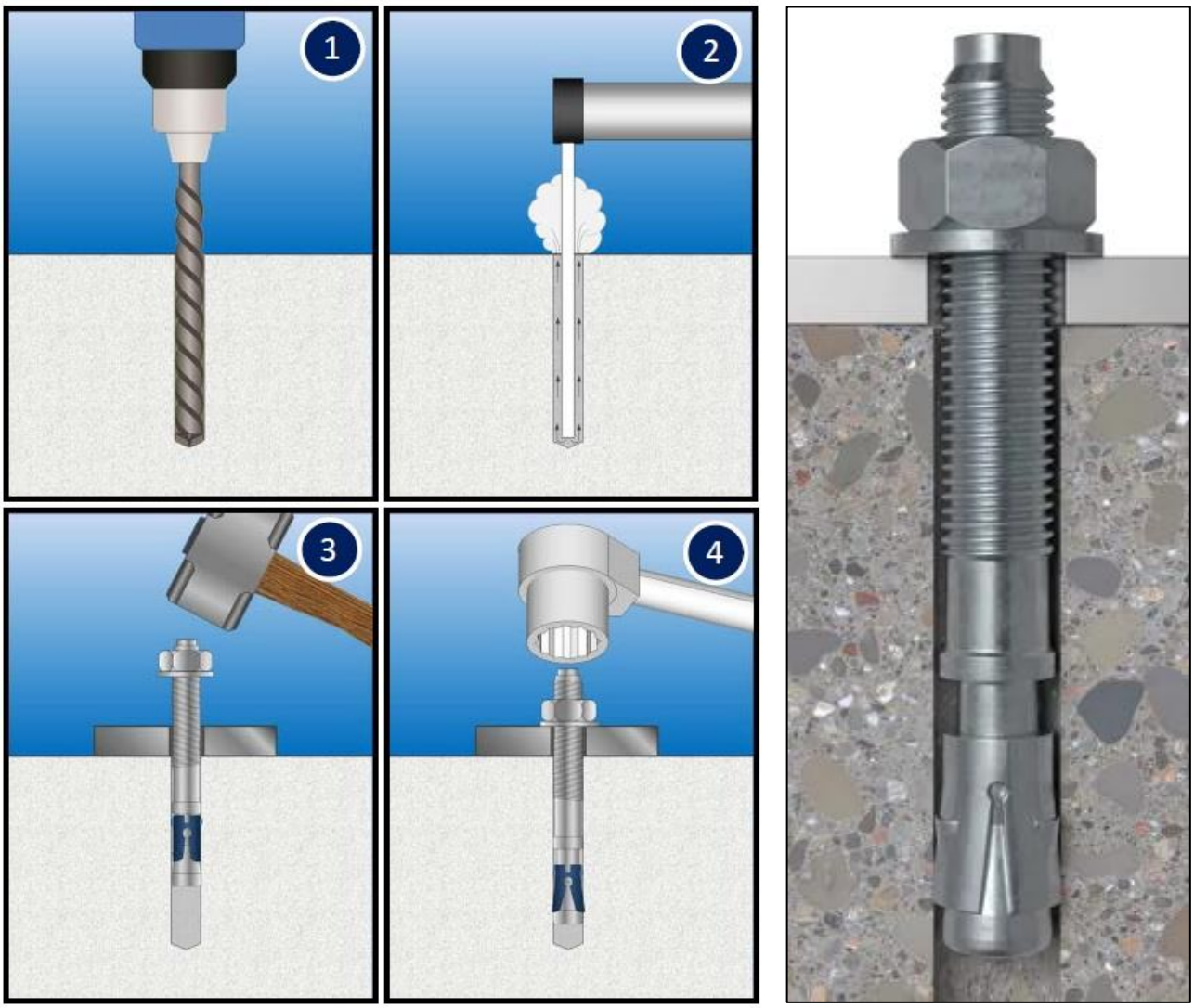


Figure 4: Fischer FBN II anchor bolt installation

11.10 Cutting & Drilling

RhinoStop® is a modular barrier system, manufactured to suit standard post spacing. During assembly, it may be necessary to cut and drill standard length panels to suit site specific dimensions.

- Cutting of w-beam guardrail panels, handrail pipe, mesh panels and angles is undertaken using a metal cutting disk.
- Drilling of holes into the guardrail panels is recommended using a step drill bit.
- Any damage to the galvanised coating shall be repaired by applying two (2) coats of a zinc rich paint. A silver topcoat is recommended for aesthetics.
- Flame cutting is not permitted for cutting or drilling of any RhinoStop® assembly item.
- Cutting of the Fischer FBN II galvanised anchors is not permitted.

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