

MashFlex

Wire Rope Safety Barrier

Product Manual

MASH TL3 COMPLIANT

MASH TL4 COMPLIANT



Release 10/25

www.ingalcivil.com.au

1.0 Introduction

Introducing MashFlex, a member of the Flexfence family, the next generation wire rope safety barrier (WRSB), providing superior motorist safety and more metres of barrier for your dollar.

MashFlex is crash tested to the latest performance standard, the Manual for Assessing Safety Hardware (MASH) Test Level 3, making it compliant to the current AS/NZS 3845.1:2015.

The superior design and clean lines of the MashFlex WRSB have seen it become the road safety industry's preferred wire rope barrier. These design characteristics have continued in this next generation of the product, MashFlex, with an improved design and simplified assembly sequence.

With the introduction of the iRAP Star Rating for a highway's safety, critical for a 5 Star rating is the separation of oncoming vehicles and protection from roadside hazards, WRSB has become a key countermeasure in these designs. Cross-median accidents are typically violent collisions with a high probability of multiple serious injuries and death.

The straight alignment of the ropes allows for easy installation and tensioning. Post footings are typically concrete with a sleeve to form a recess. Once the anchors and footings are poured, the ropes are cut to length, stainless steel end fittings are machine swaged and the ropes are tensioned.

MashFlex is a 4-rope barrier assessed in accordance with MASH Test Level 3 (TL3) and TL4.

Test Level 3 comprises two tests, the heavy vehicle impact is performed with a 2,270kg pick-up truck travelling at 100km/h and impacting the barrier at 25°, the purpose of this test is to verify the barrier's performance for impacts involving pick-up trucks and SUVs.

The small vehicle impact is performed with an 1,100kg car travelling at 100km/h and impacting the barrier at 25°, the purpose of the small car test is to evaluate the risks to the vehicle occupants when impacting a safety barrier.

TL4 requires the evaluation of the barrier when impacted by a 10,000kg rigid truck travelling at 90km/h and impacting the barrier at 15°, the purpose of this test is to evaluate the capacity of the barrier to contain and redirect the vehicle.

2.0 Specification

Material:

Steel Wire Rope: Mass – 1.21kg/m
Ultimate Tensile Strength – 165.5kN

Sigma Posts: Material to AS/NZS 1594

Anchor Bracket: Material to AS/NZS 1594

Swage Fittings: Stainless Steel, Grade 304

Plastic Parts: UV Stabilised Polypropylene

Finish:

Steel Wire Rope: Galvanised coating

Sigma Posts: Galvanised to AS/NZS 4680

Anchor Bracket: Galvanised to AS/NZS 4680

Dimensions:

Steel Wire Rope: Right Hand Lay, Ø19mm, 3 strands,
7 wires each (1 x 3.15mm + 6 x 3.0mm)

Sigma Posts: 1230mm long



Figure 1: MashFlex Wire Rope Safety Barrier

3.0 Technical Data

3.1 MashFlex Performance

Wire rope safety barriers are classified as flexible barriers and consideration must be given to the expected movement of the barrier when impacted.

The design of a WRSB should include an assessment of the mass of the impacting vehicle, its speed and angle of impact. Whilst rigorous crash testing is undertaken to evaluate the performance of roadside barriers, the deflection results obtained during testing should not be considered an exact distance, but rather as a single point within the range of deflections that can be expected.

3.2 Working Width

The working width is the maximum width that is required to prevent an impacting vehicle from colliding with an object behind a road safety barrier system. This includes the dynamic deflection and the extra width due to the roll of an impacting vehicle. The roll of a vehicle is an important consideration in shielding a fixed object hazard such as a utility pole or bridge support. Refer to Table 2 for tested working widths and Fig. 2 for more detail.

3.3 Dynamic Deflection

The dynamic deflection is defined as the largest transverse deflection of a road safety barrier system recorded during crash testing. Refer to Table 2 for tested deflections and Fig. 2 for more detail.

If the available space between the hazard and the barrier is not adequate, then the barrier can be stiffened in advance of, and alongside the hazard by reducing the post spacing. Other factors that can have an influence on the deflection of the barrier include tension in the wire rope cables, horizontal curvature and installation length.

3.4 Footing Selection

The post footing provides lateral support to the post during impact ensuring the post yields by bending near ground level. The type and size of footing is dependant upon the surrounding soil type and distance to the embankment rounding point.

Table 1 provides guidelines for the construction of concrete post footings for varying site conditions. If using the Driven Sleeve footing option, please refer to drawing WR-MF-002 and asset owner acceptance conditions prior to installation.

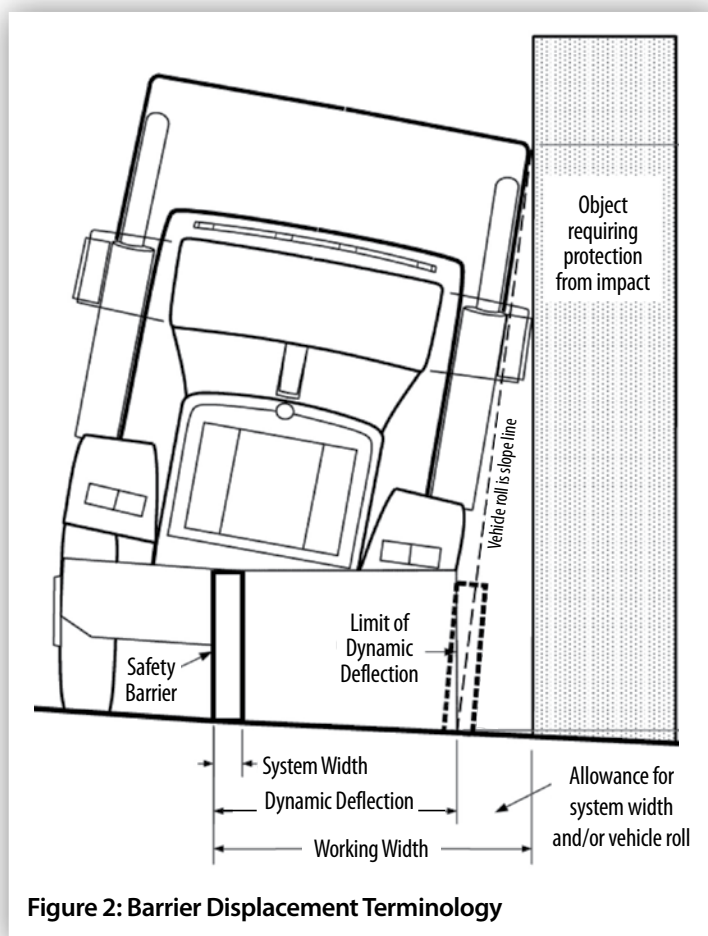


Table 1: Post Footing Selection Guide

Centre of Post Footing to Rounding Point	Standard Soil		Weak Soil	
	Dia	Depth	Dia	Depth
Less than 0.5m	300	600	300	750
Greater than 0.5m	300	600	300	750

The minimum concrete compressive strength at 28 days is 30Mpa.

In the event that the soil type cannot be verified, then a post pull-over test can be conducted to validate the structural capacity of the footing.

A pull-over test is conducted by applying a load to the top of the post whilst positioned in the proposed footing design. The footing is required to remain stable until the post yields. Once the post yields, the footing has been subjected to its maximum potential load.

For locations where the typical 600mm deep post foundation cannot be installed, a strip footing with post on baseplates is an alternative option, refer drawing WR-MF-003 for further detail.

3.5 Minimum Length

There are two geometric methods used to determine the likely trajectory of a vehicle that leaves the road in the vicinity of a roadside hazard and the minimum length of barrier required to protect from this hazard.

The most common method is the run-out length method and an alternative is a method based on angle of departure.

Prior to design or installation, designers should consult the relevant road controlling authority to establish the local jurisdictional practice as the methods may result in different lengths. Both methods are detailed in the Austroads Guide to Road Design – Part 6.3.

For instances where geometric constraints limit the installation of the recommended length under the above design methods, the absolute minimum length for a run of MashFlex is 70m, this includes a TL3 Terminal on both ends. These installations should be considered within the requirements of the road controlling authority/s Extended Design Domain.

3.6 Maximum Length

Please refer to your local road controlling authority for their max run length recommendation.

3.7 Point-of-Need

MashFlex is designed to contain and redirect errant vehicles away from road side hazards. The location along the barrier system that redirection occurs is known as the point-of-need.

The point-of need for the MashFlex system is 11.73m from the anchor point when using the MASH TL3 End Terminal.



Table 2: Crash Test Performance

Containment Level	Vehicle Wweight	Impact Speed	Impact Angle	Post Spacing	Deflection	Working Width
MASH TL3	2270 kg	100 km/h	25°	2.5m	2.19m	2.19m
MASH TL3	2270 kg	100 km/h	25°	3m	2.68m	2.73m
MASH TL4	10000 kg	90 km/h	15°	3m	2.8m	3.8m
2270P @ 80km/h	2270 kg	80 km/h	25°	2.5m	1.76m	1.9m*

* Determined from a validated FEM crash simulation model.

4.0 List of Components

ID	COMPONENT	PN
MashFlex System Components		
A	MashFlex Post 1230mm	10009358
B	MashFlex Cap	10009397
C	MashFlex Plug	10009421
D	MashFlex Plastic Sleeve	10009420
E	Post Ground Cover	10006740
F	Stainless Steel Tension Fitting	10001534
G	Reo Ring	10001580
Terminal Components		
T1	Flexfence Post 1180mm	10001671
T2	Flexfence Short Post 700mm	10009431
T3	Flexfence Steel Spreader 4 Rope	10001570
T4	Flexfence Plastic Cap	10001563
T5	Flexfence Stainless Steel Frame	10001560
T6	TL3 Flexfence Ground Cover	10001566
T7	Flexfence Anchor Bracket	10001574
T8	Cable End Fitting	10001530
T9	M24 Stainless Steel Washer	10001531
T10	M24 Stainless Steel Nut	10001532
T11	Hook Bolt Kit	10008876
T12	M20 x 350mm Hex Bolt/Nut & Washer	10009445
T13	Flexfence Type 3 Reo SL81 Mesh (default)	10008518
T14	Flexfence Type 1 Reo SL81 Mesh (alternative)	10001581
Alternative Configurations Components		
ZA	MashFlex Driven Sleeve	10007593
ZB	MashFlex Post on Baseplate	10009425

MashFlex Wire Rope Safety Barrier

MashFlex System Components



MashFlex Post 1230mm
ID: A

PN: 10009358



MashFlex Cap
ID: B

PN: 10009397



MashFlex Plug
ID: C

PN: 10009421



MashFlex Plastic Sleeve
ID: D

PN: 10009420



Post Ground Cover
ID: E

PN: 10006740



Stainless Steel Turnbuckle
ID: F

PN: 10001354



Reo Ring
ID: G

PN: 10001580



MashFlex Driven Sleeve
ID: ZA

PN: 10007593



MashFlex Post on Baseplate
ID: ZB

PN: 10009425

Terminal Components



Flexfence Post 1180mm
ID: T1

PN: 10001671



Flexfence Short Post 700mm
ID: T2

PN: 10009431



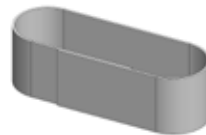
Flexfence Steel Spreader 4 Rope
ID: T3

PN: 10001570



Flexfence Plastic Cap
ID: T4

PN: 10001563



Flexfence Stainless Steel Frame
ID: T5

PN: 10001560



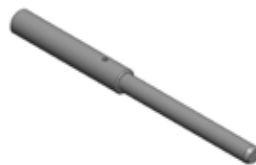
TL3 Flexfence Ground Cover
ID: T6

PN: 10001566



Flexfence Anchor Bracket
ID: T7

PN: 10001574



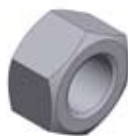
Cable End Fitting
ID: T8

PN: 10001530



M24 Stainless Steel Washer
ID: T9

PN: 10001531



M24 Stainless Steel Nut
ID: T10

PN: 10001532



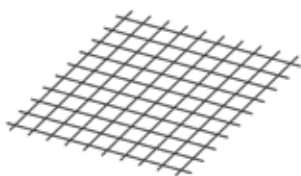
Hook Bolt Kit
ID: T11

PN: 10008876



M20 x 350mm Hex Bolt/Nut & Washer
ID: T12

PN: 10009445



Flexfence Type 3 Reo SL81 Mesh
ID: T13

PN: 10008518

5.0 End Terminals

End terminals are used to anchor the system and provide (MASH TL3 Terminal only) a soft gating impact to prevent vehicles from launching or snagging upon impact with MashFlex.

5.1 MASH TL3 Terminal

The TL3 Terminal has been crash tested to meet the requirements of MASH TL3. It can be used on all new installations or retrofitted to existing MashFlex or Flexfence installations.

The TL3 Terminal gradually tapers the cables from full height to an anchor bracket located at ground level over 10m. Refer drawing WR-MF-050 general arrangement and point of redirection.

The TL3 Terminal has demonstrated an ability to provide a soft, gating impact without releasing the cables from the anchor point. This non-release feature allows the system to remain anchored following design impacts.

This important feature contrasts terminals that are designed to release the cables for end-on impacts. Once these terminals release the cables their ability to provide continued containment and redirection for errant vehicles is compromised.

5.2 Standard Terminal (Non-Impact)

The Standard Terminal (Non-Impact) is designed to provide the necessary cable anchoring to redirect errant vehicles that impact the wire rope barrier within the length-of-need section. This terminal is not designed to be impacted and is limited to locations where geometric constraints limit the use of the TL3 Terminal and it should only be used where it is shielded behind another barrier and cannot be impacted.



Figure 3: Standard Terminal (Non-Impact)

6.0 Installation

The following written instructions should be read in conjunction with the MashFlex drawings.

A Safe Work Method Statement is available upon request to assist in the safe assembly of MashFlex.

The installation of MashFlex requires specific tooling for the swaging of the end fittings onto the cables, and also for applying the appropriate tension at the end of the installation. This equipment is known as the FlexFence Tension Unit and FlexFence Swaging Unit. Please contact your nearest Ingal representative for the safe operating instructions for this equipment.

6.1 Site Preparation

The approach terrain to the barrier should be level, otherwise a maximum grading of 1V:10H is permitted. Steeper slopes may result in the vehicle impacting the barrier at other than the design height.

6.2 Horizontal and Vertical Alignment Criteria

The length and/or horizontal curvature of an installation of wire rope barrier may increase the dynamic deflection of the barrier. In addition, horizontal curves may place more lateral load on the post foundations. Horizontal curve of less than 200m radius are not recommended.

To calculate the effect of a curve on the deflection, multiply the deflections as detailed on the system arrangement drawings by the curve correction factor in Table 3, the length column is the total length of the run. These correction factors only apply to convex curves

The minimum allowable sag vertical curve for wire rope barriers is $\geq 30\text{m}$. (K = length of VC in metres divided by the change in grade expressed as a percentage). There is no K value limit for crest curves.

6.3 End Anchor Site Preparation

The site should be inspected for the presence of underground utilities prior to any excavation. The site should be prepared free of obstructing vegetation and other hazards that may interfere with the installation or operational performance of the system. Some sites may require minor grading if installed beyond the edge of the pavement shoulder.

Table 3: Length and Curve Correction Factors

Length (m)	Convex Curve Radius (m)			
	200-299	300-449	450-749	750+
0-100	1.4	1.3	1.1	1.0
101-200	1.6	1.4	1.2	1.0
201-300	1.6	1.5	1.3	1.1
301-500	1.7	1.5	1.3	1.2
501-1000	1.8	1.6	1.4	1.2

Vehicles impacting the end of the terminals will normally continue behind and beyond the barrier and may encounter non-traversable terrain or other roadside hazards. It is recommended that the guidelines as stated in AS/NZS 3845 for the installation of gating safety barrier end terminals be observed.

AS/NZS3845 requires that a Hazard Free Zone 'immediately behind the terminal... should be reasonably traversable and free from fixed object hazards. If a clear runout is not possible, this area should be similar in character to adjacent unshielded roadside areas.'

6.4 Construction of Anchor Blocks

MashFlex is available with a variety of anchor block designs. These include;

1. Default block - Type 3 - WR-STD-64
2. Poor soil conditions - Type 1 - WR-STD-62
3. Spatial limitations - Pier - WR-STD-82

The selection of a suitable design will depend upon soil type, refer anchor drawings for minimum conditions.

Typically, the alignment of the anchor block will follow the same alignment as the length of need section. If site conditions require the anchor block to be offset to the length of need section, a 200m radius can be introduced upstream from the end anchor until the desired offset angle is achieved. The fence can then be tapered at a constant rate to achieve the required offset distance.

The construction sequence is as follows;

1. Excavate the anchor hole in accordance with the chosen anchor block drawing.
2. If installing the rectangular anchor block, clip out several grids of the reomesh square to fit over the anchor bracket as shown in Ingal drawing WR-STD-62.



Figure 4: Clipping of Reomesh

3. Attach 3 off M20 x 550mm hook bolts to the base of the anchor bracket using 2 off M20 nuts per hook bolt. One M20 nut is used either side of the anchor bracket to secure each hook bolt.

4. Using formwork, suspend the anchor bracket and reomesh, ensuring the anchor bracket levelling plate is at the same longitudinal grade as the roadway. The position of the anchor bracket is to be in accordance with the anchor block drawing.



Figure 5: Placement of Anchor Bracket

5. To prevent flotation or dislodgement during the concrete pour, drive a shortened star picket into the base or side of the excavation and use tie wire to secure the bracket.
6. Pour concrete into the excavation and vibrate. Ensure that the anchor bracket has remained secure.
7. Trowel the surface of the anchor block and shape to provide fall way from the anchor bracket.



Figure 6: Trowelling of the Anchor Block

6.5 Construction of Concrete Post Footings

1. Establish post spacing in accordance with expected dynamic deflections and excavate postholes to the dimensions in accordance with Table 1. Note that the height of the footing must be within 20mm of the design reference height.

If the sides of the postholes are seen to fall away into the hole upon coring/excavation, creating a 'coning' or tapering of the hole, the hole depth should be increased to 750mm.

2. Pour concrete into each hole.



Figure 7: Trowelling of the Post Footing

3. Insert the post footing reinforcement ring to a depth providing 50mm of cover.
4. Insert the MashFlex post into the plastic HDPE sleeve and push the plastic sleeve into the wet concrete so that the top of the plastic sleeve is at ground level. The posts are orientated so that the smooth face is towards the traffic face.
5. Trowel the surface of the post footings and shape to provide a slight fall away from the post sleeve. Any doming should not exceed 20mm in height.

6.6 Driven Sleeve Post Footings

The Driven Sleeve Footings are driven directly into the ground and should be vertical. Refer drawing WR-MF-002 for minimum ground conditions, where these conditions cannot be verified, a post pull-over test can be conducted to verify suitability.

The sleeve installation process shall not cause damage to the sleeve, such that it reduces the design life, or introduces sharp edges.

Ensure the area has been inspected for underground hazards and services prior to installation. Sleeves should be driven to a depth appropriate for the finished cable heights, as per drawing WR-MF-002.

6.7 Post on Baseplate Installation

Recommended ground beam dimensions and reinforcement specifications for new concrete foundations are provided in ICP drawing WR-MF-083, available from your local Ingal Civil representative. Two reinforcement options are given on this drawing for convenience of install. Minimum 28-day strength of concrete shall be 30MPa. Posts should be anchored to a suitable concrete foundation via four M20 G5.8 studs, chemically anchored using Hilti HY-200R, refer drawing WR-MF-003. Anchor studs shall be installed in accordance with the manufacturer's instructions.

6.8 Post Assembly Sequence

1. Slide the ground covers over each terminal and longitudinal barrier post (figure 10).
2. Starting at the leading or high end of the fence, connect the bottom cable to the anchor using a

temporary anchor connection and run out the cable through the post slots to the far anchor and cut the rope to length. Bottom cable should be inserted into anchor bracket slot nearest the traffic. When a reel is depleted, attach the end to the next reel via a tension bay, refer section 6.9.

3. Insert steel cable spreader into terminal posts 1 and 2.
4. Assemble MashFlex cap onto longitudinal barrier posts with particular attention to orientation of cap, refer embossed post profile on top of cap (figure 8).
5. Starting at the leading end of the fence, connect the second wire rope to the anchor bracket, with second cable in second anchor bracket slot from traffic, and run out the wire through the post slots up to the first MashFlex post.



Figure 8: Cap orientation embossed on cap

6. Lift MashFlex cap halfway and insert cable into second slot until the cable can slide down post centre slot. Repeat to end of run (figures 10 and 11).
7. Repeat these steps for cables 3 and 4 with both cables inserted in top slot of MashFlex cap, in accordance with drawing WR-MF-001 and figures 12 through 14. Prior to installing the top cable, ensure the stainless steel collar is installed between the top two cables of the terminal posts only.
8. When all cables have been installed, fit the plastic cap to the two terminal posts.



Figure 9: Driven Sleeve Installation

MashFlex Wire Rope Safety Barrier



Figure 10



Figure 11



Figure 12



Figure 13

MashFlex Wire Rope Safety Barrier



9. Ensure MashFlex cap is fully pushed down on post and insert MashFlex Plug into hole on side of cap, the plug is an interference fit and may require some light force from a rubber mallet. Before inserting plug, ensure the cable order is consistent and there are no twists in the pattern, i.e. the third cable is consistently in the third position for the entirety of the run. to the two terminal posts (figures 15 and 16).
10. Insert the locking bolt into the cable anchor bracket, refer figure 18.

6.9 Installation of Tension Bays

Tension bays are located at 300m centres and not more than 150m from either anchor point. This section is to be read in conjunction with drawing WR-MF-059.

For fences less than 600m:

1. Swage the stainless steel end fittings onto all the cables and attach to the anchor bracket. The procedure for swaging is contained in the FlexFence Swaging Unit Safe Operating Procedure Manual. The bottom rope is located nearest to the approaching traffic face. Each end fitting is secured at the anchor with one washer and two nuts. If using the standard terminal, ensure safety check ropes are attached before swaging.
- Note: An inspection hole is drilled into each stainless steel end fitting to ensure the wire rope cables are properly inserted into the end fittings before swaging.*
2. Pull the slack out of the wire ropes toward the other anchor. This can be achieved by hand or by using a sling equipped with a lever claw clamp.
3. At locations where the wire rope reels have been temporarily joined, swage the end fittings onto the cables and install a tension fitting. End fittings should be positioned so that the end of the fitting is a minimum distance of 100mm from the post.
4. After the slack has been removed from the fence, attach the check ropes (if required), machine swage the end fittings and attach to the trailing or low-end anchor.
5. Identify the tension bay location(s).
6. Mark and cut out an 800mm section from bottom, second from bottom and top cables. Move past the adjacent post and cut the 800mm section from the third from bottom cable. This offsetting of the tension bay for this cable will help expedite the tensioning process. It may be necessary to attach temporary clamps one post back from the tension bay location prior to cutting in order to prevent the cables from retracting. End fittings should be positioned so that the end of the fitting is a minimum distance of 100mm from the post. Refer drawing WR-MF-059

and figure 19.

7. Swage the end fittings to each cable and attach the tension fittings. The procedure for swaging is contained in the FlexFence Swaging Unit Safe Operating Procedure Manual.
8. Attach the tensioning rig to the bottom cable and tension from the bottom up. The procedure for Tensioning is contained in the FlexFence Tension Unit Safe Operating Procedure Manual. Each rope is tensioned in accordance with Table 5.

For fences greater than 600m:

1. Attach the safety check ropes (if required) and machine swage the cables at the leading or high-end anchor and attach to the anchor bracket.
2. Pull the slack out of the wire ropes towards the 1st tension bay location. This can be achieved by hand or by using a sling equipped with a lever claw clamp.
3. At the 1st tension bay location clamp the wire rope cable to a post. Repeat process for each cable, clamping each cable to a different post.
4. Cut the cables on the un-tensioned side of clamps and machine swage fittings. Assemble the tension fittings.
5. Relocate to the 2nd tension bay and repeat the above process. Continue until all the tension bays are completed.
6. Once the slack has been removed from the fence, attach the check ropes (if required), swage the end fittings and attach to the trailing or low-end anchor.
7. Once the cables are attached at the anchor bracket, relocate to the centre tension bay.
8. Attach the tensioning rig and tension in accordance with Table 5 from the bottom up.
9. Relocate from the centre bay outwards repeating the tension process.
10. Once complete, relocate to the centre bay and repeat tensioning in this bay only.

Note: Upon completion, the tension bays shall not be more than 90% (40mm gap) of their full extent so as to allow for further adjustment. There should also be a min 40mm exposed thread beyond each nut.

It is recommended that concrete used for the construction of anchor blocks and post footings be cured for a period of 7 days prior to tensioning.



Table 4: Construction Tolerances

Description	Recommended Tolerance
Rope Height	-10mm / +30 mm
Post Spacing	± 30mm
Post Footing Dimensions	- 10mm
Anchor Block Dimensions	- 20mm
Cable Tension	- 1kN / +2kN

Table 5: Tension Unit Pressure Requirements

Ambient Temperature °C	Cable Tension (Tension Unit Bar)
- 5	36kN (386)
0	34kN (363)
5	32kN (340)
10	29kN (316)
15	27kN (293)
20	25kN (270)
25	23kN (247)
30	21kN (224)
35	19kN (201)
40	17kN (177)



Figure 18: Anchor bracket with locking bolt

6.10 Clean-up and Waste Materials

Recycle, reuse or dispose of all surplus material, rubbish and other debris in accordance with the requirements of the local state based environmental protection specification. Generally all components can be recycled. Posts and cables are made from a galvanised steel. Post caps are Nylon.



Figure 19: MashFlex Tension Bay

7.0 MashFlex Maintenance

MashFlex is a low maintenance roadside safety barrier. Except for repairs due to impacts, there is virtually no maintenance required for the system. It is recommended that regular drive-by inspections be performed to ensure the following;

1. Post caps have not dislodged from terminal posts. Delineation stickers are attached to the post caps and a loss of numerous caps could result in poor delineation.
2. Debris has not accumulated around the system. A clear zone, free of hazards should exist immediately behind the fence to accommodate for the expected dynamic deflection.
3. Safety check ropes should be secured to the anchor - Standard Terminal only. Refer WR-MF-55.
4. Ropes have not dislodged from the posts as a result of minor impacts.

7.1 Cable Tension

MashFlex is supplied with pre-stretched wire rope. The pre-stretching process removes the constructional stretch in the wires as they 'bed-down'. Wire rope is essentially an elastic member and will not require retensioning after most impacts. For fences subjected to regular vehicle impacts or large seasonal temperature variations, it may be necessary to evaluate the rope tension annually. This can be undertaken using the FlexFence Tension Unit.

If using a Tension Meter which does not attach to Tension Fittings, Tension should be measured within 5m of Tension Fittings.

7.2 Bush Fire Damage ¹

The performance of galvanized coatings when subjected to bushfire depends on a number of factors, such as flame duration, intensity and the characteristics of the galvanized coating and the technology with which it is applied.

Typical bushfire conditions may expose steel structures to air temperature of 800°C for periods of up to 120 seconds, however zinc coatings are generally reflective and will not absorb heat at the same rate as an uncoated steel surface. Depending on the section thickness of the steel, the actual steel surface temperatures may not exceed 350°C.

Typically, the bushfire flame duration and intensity are not high enough to compromise the structural strength of the steel. The hot dip galvanized coating will thus remain largely unaffected through a bushfire event. If the bushfire causes damage to the galvanized surface, then the item(s) shall be replaced.

7.3 Damage Assessment

In the event of a vehicle impact, damage to the barrier is to be assessed in accordance with Table 6. In the event that the ropes are to be cut, they are NOT to be cut under tension.

A Safe Work Method Statement is available upon request to assist in the safe repair of MashFlex.

¹ Information based upon testing conducted on behalf of BlueScope Steel by the CSIRO Manufacturing and Infrastructure Technology Bushfire CRC in 2005.



7.4 Emergency Dismantling

Due to the dynamic nature of a traffic accident, safety barriers may inhibit access of rescue personnel to the vehicle, or crash site, and may need to be moved. Interfering with the WRSB at a crash site may be hazardous due to the potential latent tension in the cables and all de-tensioning should be conducted by trained personnel at the tension bays.

In an emergency situation, where waiting for a trained WRSB install crew is not viable, cutting the cables may be deemed absolutely necessary. Please note, this can be a very dangerous task and a thorough risk assessment should be conducted before the cutting commences. If the cables are under tension, any interference may cause them to release.

There are two options to cut the cable, the preferred option is to cut the turnbuckle on each cable. Turnbuckles should be located every 300m approximately. Alternatively, the cables can be cut with a disc grinder.

Before commencing any cutting:

- Ensure all personnel are in a safe location.
- Do not stand on the concave side of restrained cables.
- Do no cut in close proximity to the crash scene.

A video demonstration of how to work with, and around, high tension WRSB can be viewed at:

<https://www.ingalcivil.com.au/wrsb-emergency-cut>.



8.0 Product Storage

Most components of the MashFlex system are galvanized steel. It is important that stored galvanized work is stacked so that each item is well ventilated and can adequately drain rainwater from its surfaces.

Poor storage of galvanized product can give rise to wet storage staining (white rust) which is caused by water (rain or condensation) in badly drained or ventilated conditions. This can occur very quickly, particularly in warm, humid conditions.

Table 6: Damage Assessment

Type of Defect	Description of the Defect	Action to be Taken
Galvanizing damage on Posts.	The sum total of the damaged or uncoated areas does not exceed 10cm ² (0.5% of the total surface area). The sum total of the damaged or uncoated areas exceeds 10cm ² (0.5% of the total surface area).	An organic zinc rich epoxy paint, complying with AS/NZS 3750.9, is to be applied to the repair areas in two coats. The post is to be replaced.
Galvanizing Damage on Wire Rope Cable	The wire rope is nicked or gouged to less than 10% depth. The wire rope is nicked or gouged greater than 10% depth.	An organic zinc rich epoxy paint, complying with AS/NZS 3750.9, is to be applied to the repair areas in two coats. The wire rope section is to be replaced.
Mechanical Damage on Wire Rope Cable (Refer drawing WR-STD-59)	Any rope length containing more than 1 broken wire. Any rope where the diameter is reduced by more than 10% by abrasion. Any rope which has been crushed or flattened by more than 10% of its nominal diameter.	The rope section is to be replaced. The rope section is to be replaced The rope section is to be replaced.
Mechanical damage on Posts.	The post is distorted.	The post is to be replaced.
Damaged End Fitting	There is damage to the thread of the fitting, however tension can be maintained in the wire rope system without relying on the fitting. There is damage to the thread of the fitting and tension cannot be maintained in the wire rope system without relying on the fitting. The fitting is cracked. The body of the fitting is distorted.	There is no requirement for immediate replacement. The location of the fitting should be noted and scheduled for replacement during routine maintenance. The fitting is to be replaced. The fitting is to be replaced. The fitting is to be replaced.
Damaged Tension Fitting	The fitting is cracked. The body of the fitting is distorted.	The fitting is to be replaced. The fitting is to be replaced.
Damaged Driven Sleeve	Sleeve opening is significantly distorted from yielding post. Sleeve is dislocated causing new post to be out of alignment.	Install a new sleeve 200mm upstream or downstream of damaged sleeve. Install a new sleeve 200mm upstream or downstream of damaged sleeve.
Damaged Post Footing	Footing cracked causing replaced post to be out of alignment. Footing is dislocated causing replaced post to be out of alignment.	Install a new footing 200mm upstream or downstream of damaged footing. Install a new footing 200mm upstream or downstream of damaged footing.

MashFlex Tensioning Report And Checklist

Customer:

Project:

Fence ID:

Fence Length:

Ambient Temperature:

Tensioning Force:

Checked By:

Signed:

Date

End Terminals

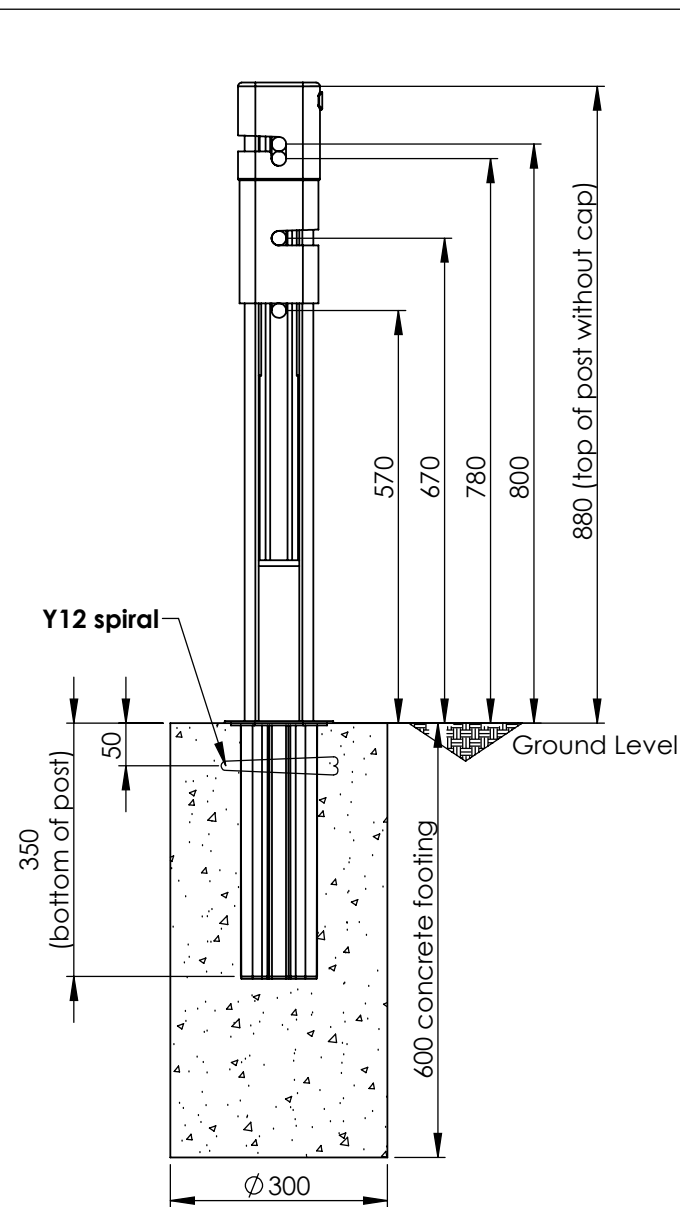
Is the anchor block dimensions in accordance with the chosen anchor block drawing	☐ Yes	☐ No
Has the anchor bracket been installed with the levelling plate at the same longitudinal grade as the roadway	☐ Yes	☐ No
Have check ropes been attached to the cables and anchor bracket (drawing WR-MF-55 only)	☐ Yes	☐ No
Have steel cable spreaders been used in both terminal posts	☐ Yes	☐ No
Has each end fitting been secured with one washer and two nuts	☐ Yes	☐ No
Has the stainless frame been inserted between the top and second from top cable	☐ Yes	☐ No
Have post caps been attached to the posts	☐ Yes	☐ No
Has the anchor cable locking bolt been installed with nuts tightened to snug	☐ Yes	☐ No

Longitudinal Barrier Posts

Have the posts been installed at the correct spacing	☐ Yes	☐ No
Have the posts been installed with the correct orientation towards approaching traffic	☐ Yes	☐ No
Have ground covers been installed on each post	☐ Yes	☐ No
Has delineation been attached to the post caps	☐ Yes	☐ No
Is the cable order consistent throughout the run	☐ Yes	☐ No
Has a MashFlex plug been inserted into each cap	☐ Yes	☐ No
Has any minor damage been repaired using two coats of an organic zinc rich paint	☐ Yes	☐ No

Tension Bays

Have tension bays been installed at not more than 150m from the end anchors	☐ Yes	☐ No
Have tension Bays been installed at not more than 300m apart	☐ Yes	☐ No

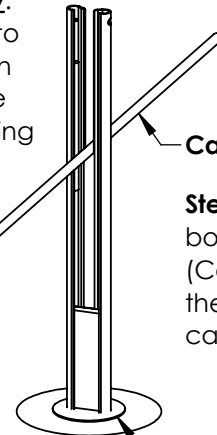


Wire Rope Assembly:

Step 1: Insert post into concrete foundation with the closed face towards the oncoming traffic.

Step 2: Fit ground cover over post at ground level.

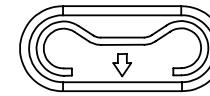
Traffic Direction



Cable 1

Step 3: Insert bottom cable (Cable 1) to the end of the cable slot.

Ground cover

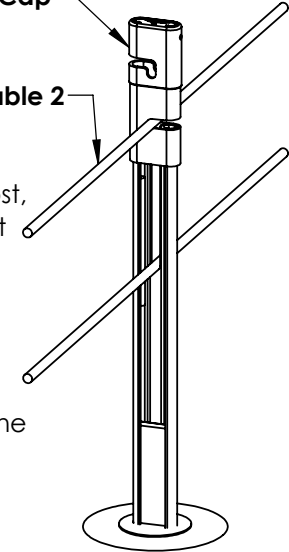


MashFlex Cap

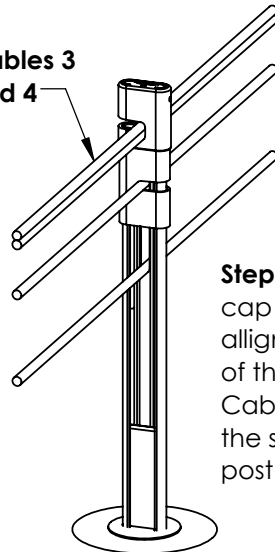
Cable 2

Step 4: Fit the MashFlex cap on the top of the post, ensure orientation of post corresponds with profile embossed on the cap.

Step 5: Position the cap until its bottom slot is aligned with the top of the post. Then insert Cable 2 into the slot and into the post.

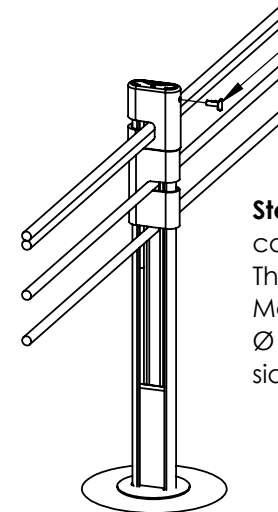


Cables 3 and 4



Step 6: Position the cap until its top slot is aligned with the top of the post. Then insert Cables 3 and 4 into the slot and into the post.

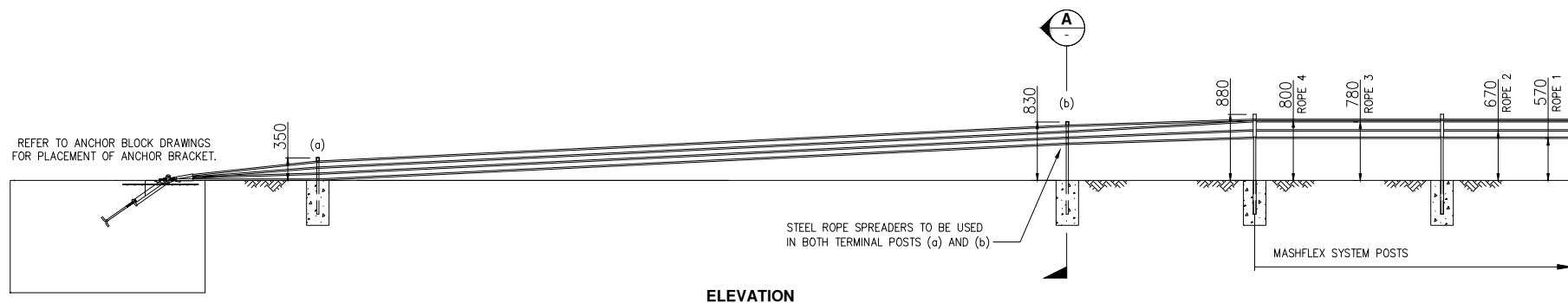
MashFlex Plug



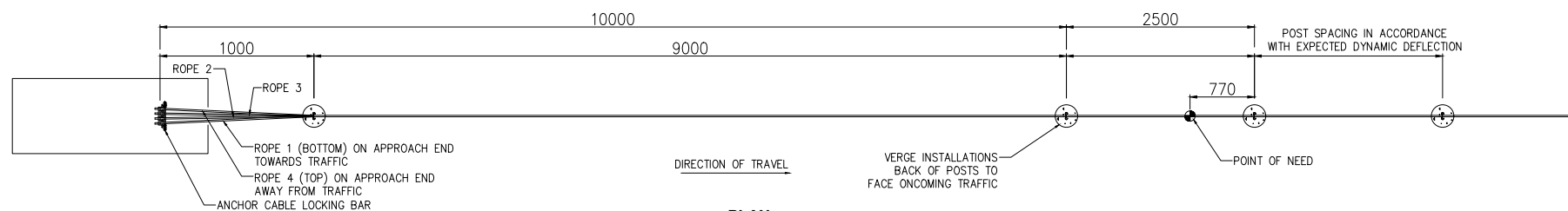
Step 7: Insert the cap all the way. Then insert the MashFlex Plug into Ø10mm hole on side of cap.

NOTE: TO BE READ IN CONJUNCTION WITH THE MASHFLEX PRODUCT MANUAL.

REVISIONS							REFERENCES									 INGAL CIVIL PRODUCTS A valmont COMPANY DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS. 57-45 PARKER ROAD MARTO, N.S.W. 2566 PH. +61 2 9827 3333 www.ingalcivil.com.au PH. +61 2 9827 3333 www.ingalcivil.com.au	PROJECT	MASHFLEX WRSB		INGAL CIVIL PRODUCTS PART No.
1	29-10-2019	ADDED STEP 2, GROUND COVER, UPDATED TEXT	VB	LG	LG															
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED			DRAWING NUMBER	REFERENCE DRAWINGS											

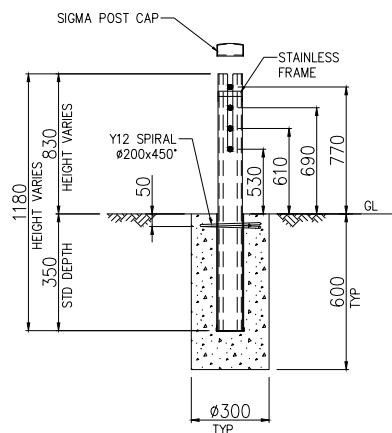
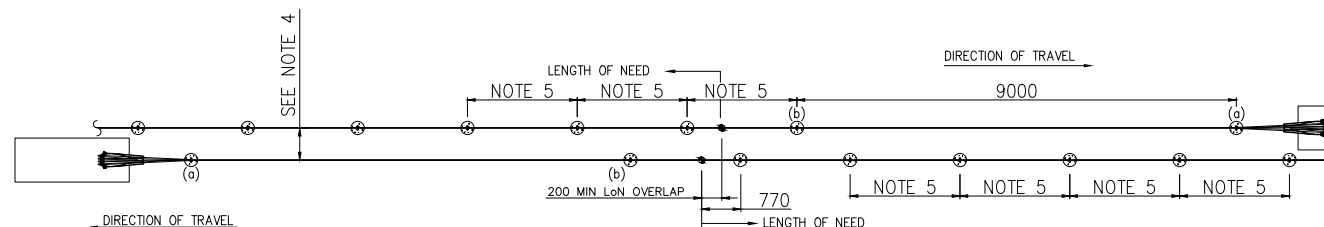


ELEVATION



PLAN

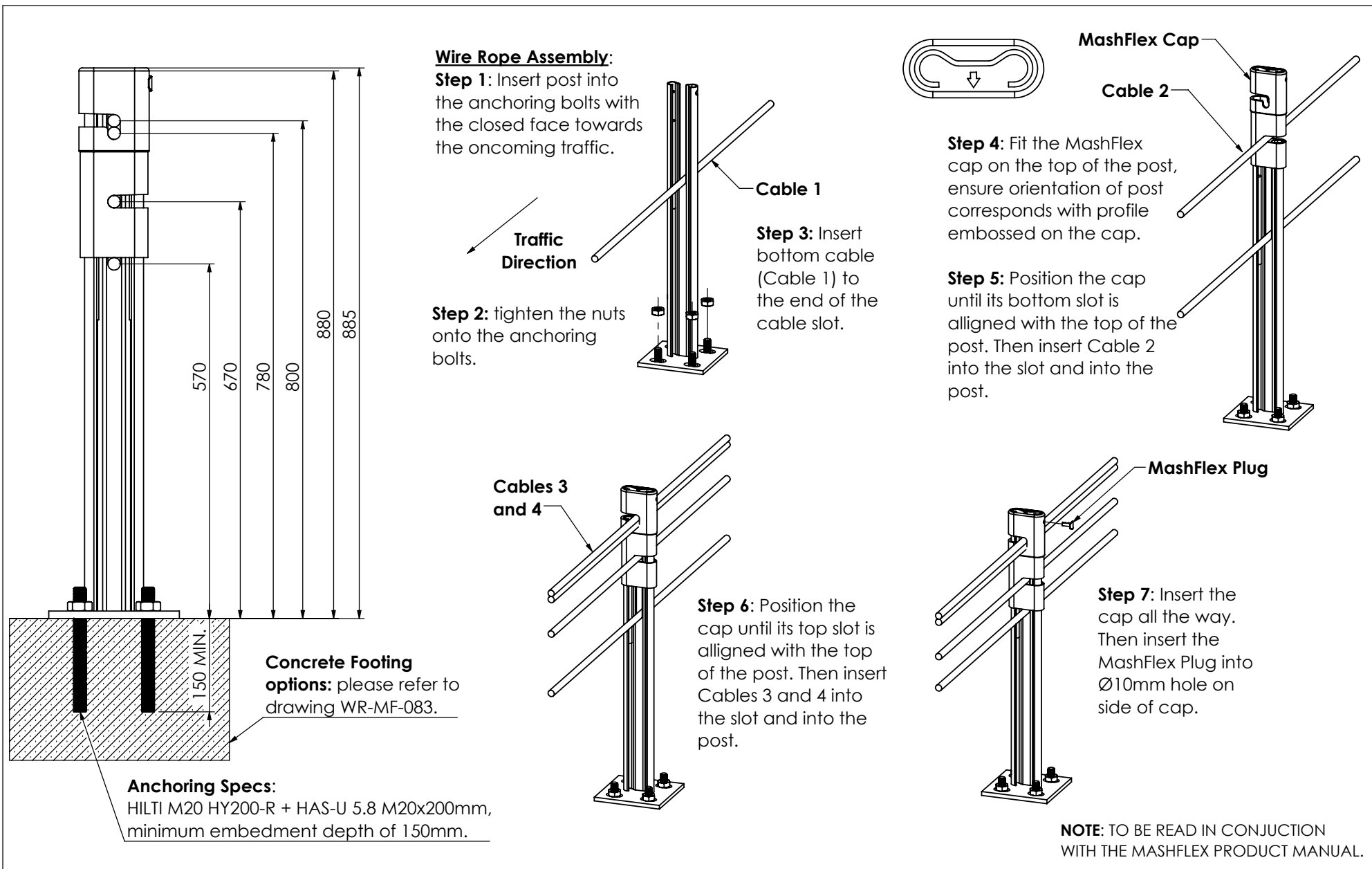
ITEM No.	POST LENGTH
a	700
b	1180

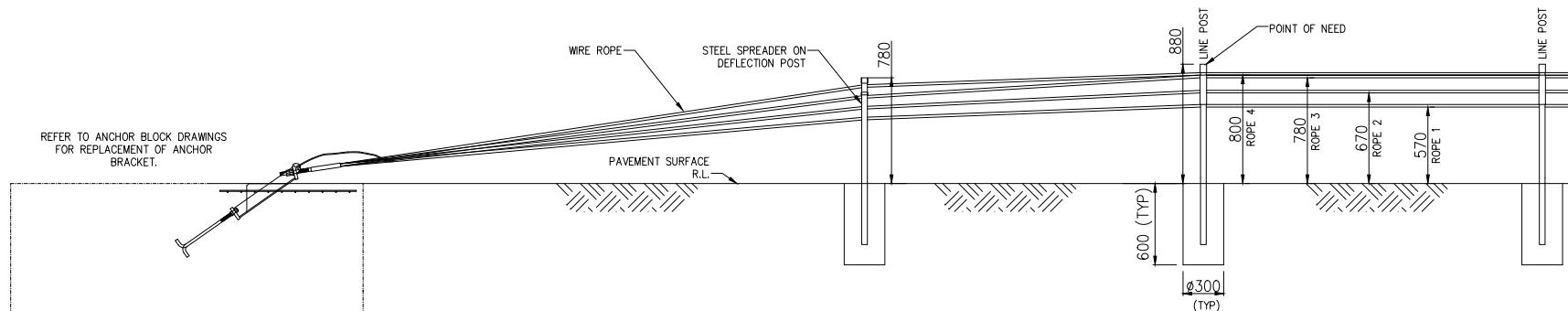
SECTION A
NTSINTERMEDIATE ANCHOR GENERAL ARRANGEMENT
NTS (DIMENSIONS INDICATIVE OF 2.5m BARRIER POST SPACING)

NOTES:

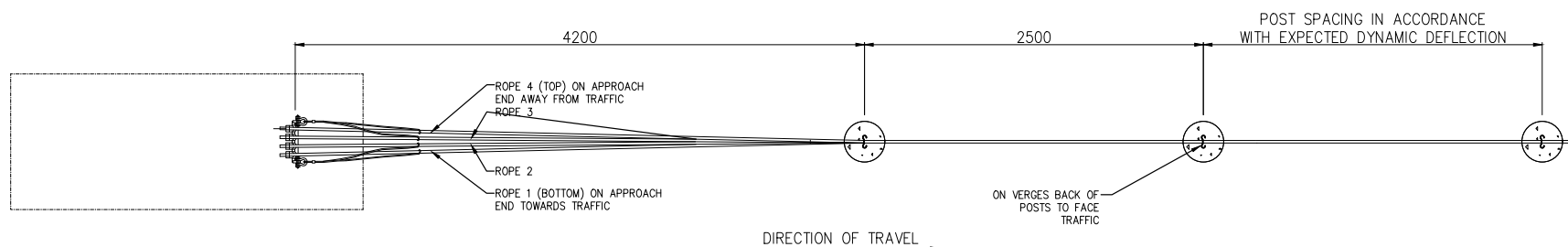
1. DIMENSIONS SHOWN ARE IN mm UNLESS OTHERWISE STATED.
2. LENGTH OF NEED OVERLAP FOR INTERMEDIATE ANCHOR TO BE MINIMUM 200mm FOR A MASHFLEX INSTALLATION WITH A POST SPACING OF 2.5m OR 3.0m.
3. SAFETY CHECK ROPES NOT REQUIRED ON THIS TERMINAL.
4. DISTANCE BETWEEN TERMINALS AS PER LOCAL ROAD AUTHORITY REQUIREMENTS.
5. POST SPACING OF LONGITUDINAL BARRIER TO BE IN ACCORDANCE WITH THE EXPECTED DEFLECTION/WORKING WIDTH. TYPICALLY 2.5m OR 3m.

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	NAME	DATE	PROJECT	TITLE	INGAL CIVIL PRODUCTS PART No.	DRAWING No.	Rev
7	23-08-2024	NOTE 4 UPDATED	KZ	HF	KZ					INGAL CIVIL PRODUCTS A valmont COMPANY	MASHFLEX WRSB	TL3 END TERMINAL	WR-MF-050	7
6	15-07-2021	PON UPDATED ON INTERMEDIATE OVERLAP	VB	LG	LG			DRAWN	28-10-2019					
5	15-03-2021	NOTE 2 UPDATED	VB	BM	LG			CHECKED	28-10-2019					
4	11-06-2020	POST SPACING & NOTE 5 UPDATED	LG	VB	LG			APPROVED	28-10-2019					
3	20-04-2020	POINT OF NEED UPDATED	VB	LG	LG			SCALE	N.T.S. @ A3					
2	10-12-2019	POINT OF NEED UPDATED	VB	LG	LG			ISSUE FOR	INFORMATION ONLY	DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS. 57-65 AIRDS ROAD MINTO, N.S.W 2566 PH. +61 2 9827 3333 www.ingalcivil.com.au				
1	28-11-2019	POINT OF NEED & CABLE LOCKING BAR ADDED	VB	LG	LG									

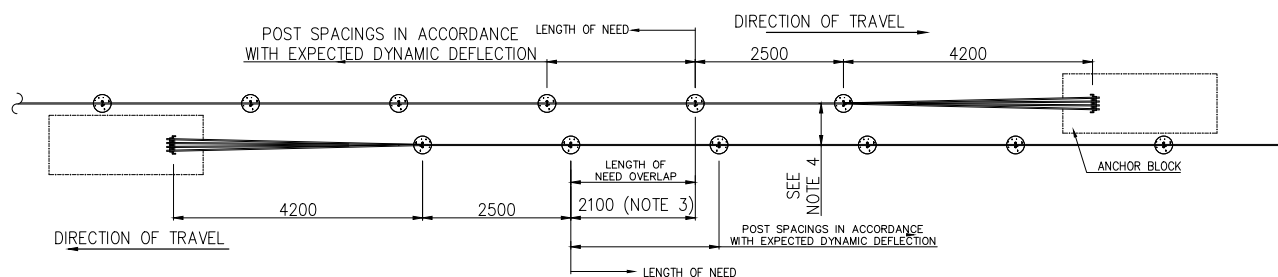




ELEVATION



PLAN

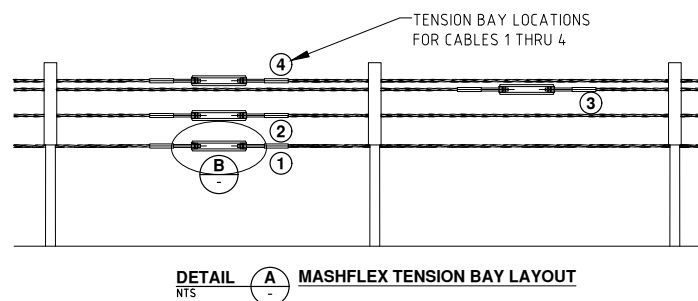
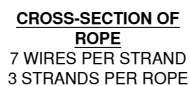
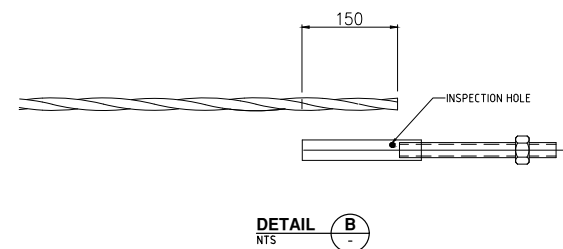


INTERMEDIATE ANCHOR GENERAL ARRANGEMENT

NOTES:

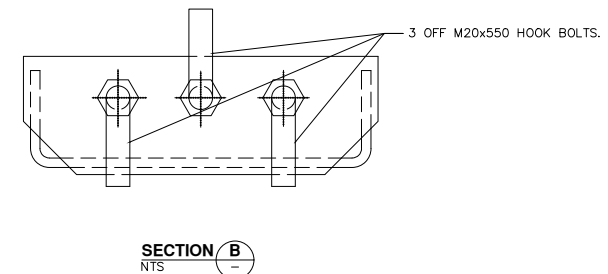
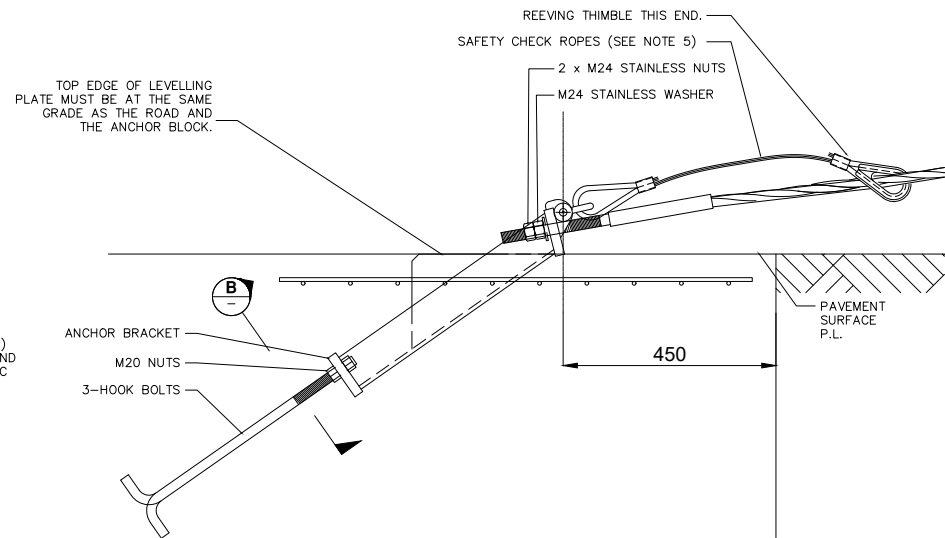
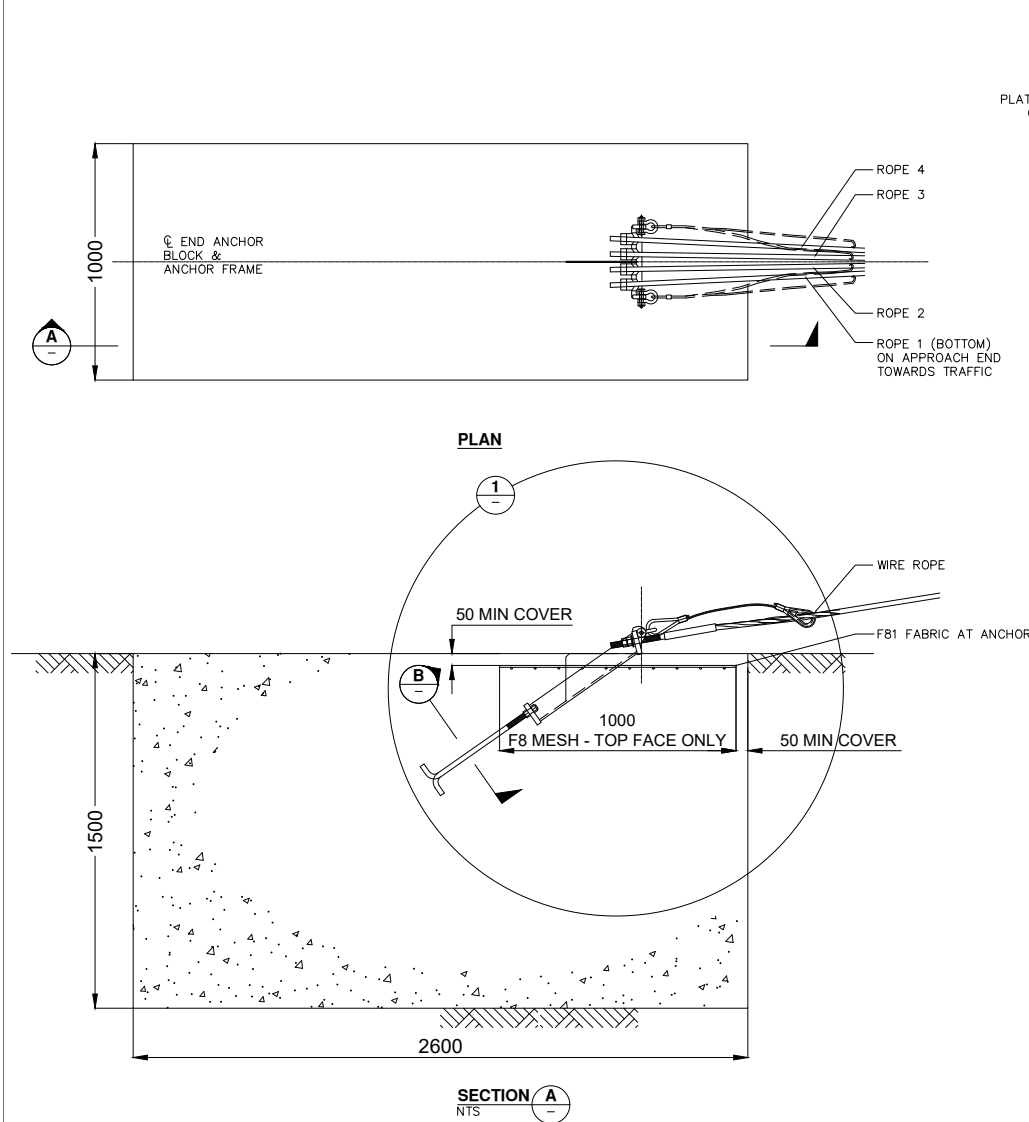
1. USE OF THIS TERMINAL IS LIMITED TO LOCATIONS WHERE GEOMETRIC CONSTRAINTS LIMIT USE OF TL3 TERMINAL. PLEASE CONTACT YOUR LOCAL ICP REPRESENTATIVE FOR FURTHER ADVICE PRIOR TO DESIGN OR INSTALLATION. APPROVAL MAY BE REQUIRED FROM ROAD CONTROLLING AUTHORITY.
2. DIMENSIONS SHOWN ARE IN mm UNLESS OTHERWISE STATED.
3. LENGTH OF NEED OVERLAP FOR INTERMEDIATE ANCHOR TO BE 2100mm FOR A MASHFLEX INSTALLATION WITH A POST SPACING OF 2.5m, CONTACT YOUR ICP REPRESENTATIVE FOR OVERLAP WHEN USING A DIFFERENT POST SPACING.
4. DISTANCE BETWEEN TERMINALS AS PER LOCAL ROAD AUTHORITY REQUIREMENTS.

REVISIONS				REFERENCES				NAME	DATE		PROJECT	INGAL CIVIL PRODUCTS PART No.
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED	DRAWING NUMBER	REFERENCE DRAWINGS	DRAWN	DATE		MASHFLEX WRSB	
1	23-08-2024	NOTE 4 UPDATED	KZ	HF	KZ			CHECKED	LG			
								APPROVED	LG		TITLE	DRAWING No.
								SCALE	N.T.S. @ A3		STANDARD END TERMINAL (NON IMPACT)	WR-MF-055
								ISSUE FOR	INFORMATION ONLY	DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS 57-65 AIRDS ROAD MINTO, N.S.W 2566 PH. +61 2 9827 3333 www.ingalcivil.com.au		Rev: 1



2. ALL MEASUREMENTS ARE IN mm UNLESS STATED OTHERWISE. UPON COMPLETION, THE TENSION BAYS SHALL NOT BE MORE THAN 90% (40mm GAP) OF THEIR FULL EXTENT TO ALLOW FOR FURTHER ADJUSTMENT. THE NUTS SHOULD ALSO HAVE A MINIMUM 40mm EXPOSED THREAD BEYOND NUT WHEN TENSIONED.

REVISIONS							REFERENCES								 INGAL CIVIL PRODUCTS a valmont company	PROJECT	MASHFLEX WRSB	INGAL CIVIL PRODUCTS PART No.	
	0		ORIGINAL ISSUE																
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED		DRAWING NUMBER	REFERENCE DRAWINGS								TITLE	TENSION PANEL ARRANGEMENT	DRAWING No. WR-MF-059	



NOTES

1. CONCRETE TO HAVE MINIMUM 28 DAY STRENGTH OF 25 MPa.
2. MINIMUM CLEAR COVER TO BE 75 mm.
3. THE AVERAGE MATERIAL-INTERNAL ANGLE OF FRICTION OVER THE DEPTH OF THE ANCHOR WHEN MEASURED USING AN APPROVED METHODOLOGY SHALL EXCEED THE FOLLOWING:
 - $\Phi = 20$ DEGREES
 - $\gamma = 12 \text{ kN/m}^3$
 - $C_u = 20 \text{ kPa}$
4. ALL UNITS ARE IN MM UNLESS NOTED OTHERWISE.
5. SAFETY CHECK ROPES ONLY REQUIRED WITH STANDARD TERMINAL.

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
8	25-02-2022	NOTE NUMBER FIXED	KZ	LG	LG
7	01-09-2020	DIMENSION FIXED	VB	LG	LG
6	29-10-2019	TITLE BLOCK UPDATED, NOTE 5 UPDATED	VB	LG	LG
5	13-12-2018	NOTE ADDITIONS - SOIL CONDITIONS	MC	LG	LG
4	17-10-2018	NOTE 4 ADDED	LG	SE	LG
3	08-02-2013	SAFENCE NOTE ADDED	LG	SE	LRB
2	02-11-2011	TITLE BLOCK UPDATED	DJB	TC	TC
1	12-02-2010	INITIAL ISSUE	MS	TC	TC

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
8	25-02-2022	NOTE NUMBER FIXED	KZ	LG	LG
7	01-09-2020	DIMENSION FIXED	VB	LG	LG
6	29-10-2019	TITLE BLOCK UPDATED, NOTE 5 UPDATED	VB	LG	LG
5	13-12-2018	NOTE ADDITIONS - SOIL CONDITIONS	MC	LG	LG
4	17-10-2018	NOTE 4 ADDED	LG	SE	LG
3	08-02-2013	SAFENCE NOTE ADDED	LG	SE	LRB
2	02-11-2011	TITLE BLOCK UPDATED	DJB	TC	TC
1	12-02-2010	INITIAL ISSUE	MS	TC	TC

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
8	25-02-2022	NOTE NUMBER FIXED	KZ	LG	LG
7	01-09-2020	DIMENSION FIXED	VB	LG	LG
6	29-10-2019	TITLE BLOCK UPDATED, NOTE 5 UPDATED	VB	LG	LG
5	13-12-2018	NOTE ADDITIONS - SOIL CONDITIONS	MC	LG	LG
4	17-10-2018	NOTE 4 ADDED	LG	SE	LG
3	08-02-2013	SAFENCE NOTE ADDED	LG	SE	LRB
2	02-11-2011	TITLE BLOCK UPDATED	DJB	TC	TC
1	12-02-2010	INITIAL ISSUE	MS	TC	TC

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
8	25-02-2022	NOTE NUMBER FIXED	KZ	LG	LG
7	01-09-2020	DIMENSION FIXED	VB	LG	LG
6	29-10-2019	TITLE BLOCK UPDATED, NOTE 5 UPDATED	VB	LG	LG
5	13-12-2018	NOTE ADDITIONS - SOIL CONDITIONS	MC	LG	LG
4	17-10-2018	NOTE 4 ADDED	LG	SE	LG
3	08-02-2013	SAFENCE NOTE ADDED	LG	SE	LRB
2	02-11-2011	TITLE BLOCK UPDATED	DJB	TC	TC
1	12-02-2010	INITIAL ISSUE	MS	TC	TC

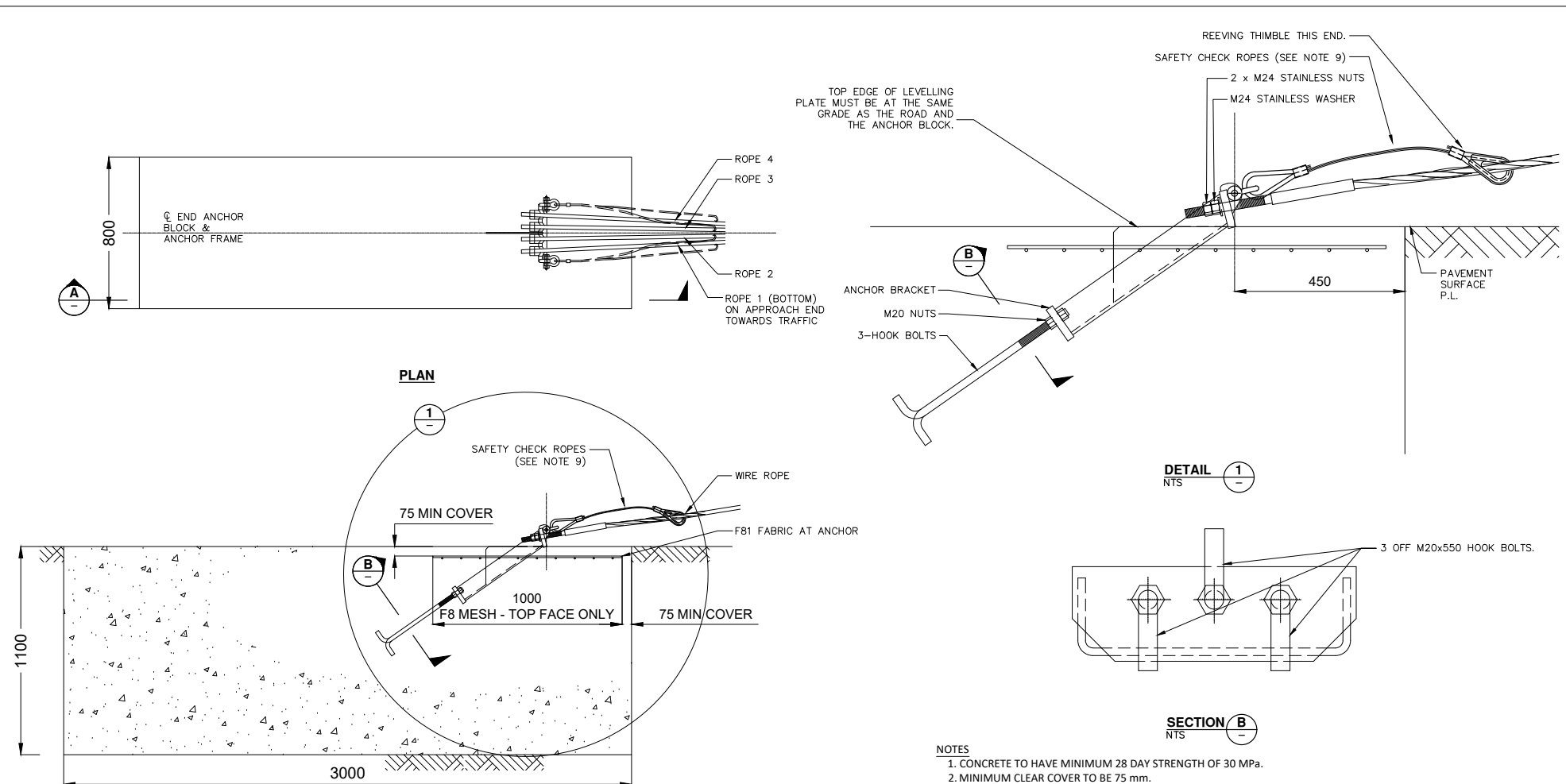
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
8	25-02-2022	NOTE NUMBER FIXED	KZ	LG	LG
7	01-09-2020	DIMENSION FIXED	VB	LG	LG
6	29-10-2019	TITLE BLOCK UPDATED, NOTE 5 UPDATED	VB	LG	LG
5	13-12-2018	NOTE ADDITIONS - SOIL CONDITIONS	MC	LG	LG
4	17-10-2018	NOTE 4 ADDED	LG	SE	LG
3	08-02-2013	SAFENCE NOTE ADDED	LG	SE	LRB
2	02-11-2011	TITLE BLOCK UPDATED	DJB	TC	TC
1	12-02-2010	INITIAL ISSUE	MS	TC	TC

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
8	25-02-2022	NOTE NUMBER FIXED	KZ	LG	LG
7	01-09-2020	DIMENSION FIXED	VB	LG	LG
6	29-10-2019	TITLE BLOCK UPDATED, NOTE 5 UPDATED	VB	LG	LG
5	13-12-2018	NOTE ADDITIONS - SOIL CONDITIONS	MC	LG	LG
4	17-10-2018	NOTE 4 ADDED	LG	SE	LG
3	08-02-2013	SAFENCE NOTE ADDED	LG	SE	LRB
2	02-11-2011	TITLE BLOCK UPDATED	DJB	TC	TC
1	12-02-2010	INITIAL ISSUE	MS	TC	TC

ENGINEERING SALES & MARKETING DRAWINGS / FLEXFENCE ASSEMBLY / WRSB / STD-02 / TYPE 1 ANCHOR BLOCK.DWG

Release 10/25

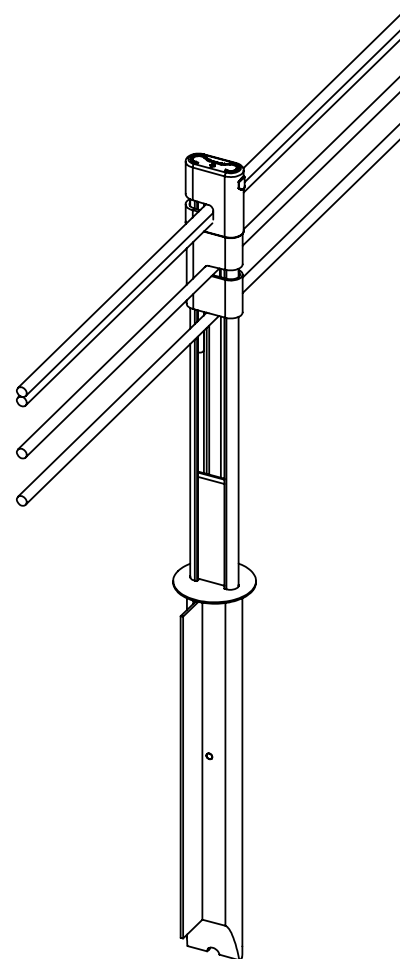
23



NOTES

1. CONCRETE TO HAVE MINIMUM 28 DAY STRENGTH OF 30 MPa.
2. MINIMUM CLEAR COVER TO BE 75 mm.
3. THE AVERAGE MATERIAL-INTERNAL ANGLE OF FRICTION OVER THE DEPTH OF THE ANCHOR WHEN MEASURED USING AN APPROVED METHODOLOGY SHALL EXCEED THE FOLLOWING:
 - $\Phi = 30$ DEGREES
 - $\gamma = 19$ kN/m³
 - $C_u = 35$ kPa
4. FOR SITES WITH UNCONVENTIONAL GEOMETRIES, HIGH WATER TABLES, ALTERNATIVE SOIL TYPES, OR UNUSUAL SITE SPECIFIC VARIABLE, AN ALTERNATIVE ANCHOR DESIGNS WILL BE REQUIRED. PLEASE SEEK ADVICE FROM A QUALIFIED GEOTECHNICAL ENGINEER OR YOUR LOCAL INGAL SALES REPRESENTATIVE.
5. FOR MIXED SOIL TYPES, A CONSERVATIVE APPROACH OF ASSUMING THE WEAKER SOIL PROPERTIES FOR THE FULL DEPTH IS RECOMMENDED. OTHERWISE, CONTACT A QUALIFIED GEOTECHNICAL ENGINEER.
6. FOR ADDITIONAL GUIDANCE, PLEASE CONTACT YOUR LOCAL INGAL SALES REPRESENTATIVE.
7. ALL UNITS ARE IN MM UNLESS NOTED OTHERWISE.
8. INGAL CIVIL PRODUCTS MARKET THIS SYSTEM UNDER THE TRADE NAME SAFENCE IN NEW ZEALAND.
9. SAFETY CHECK ROPES ARE ONLY REQUIRED ON THE STANDARD TERMINAL, NOT THE TL3 TERMINAL.

REV DATE DESCRIPTION DRAWN CHECKED APPROVED	7	01-09-2020	DIMENSION FIXED	VB	LG	LG	REFERENCES DRAWING NUMBER REFERENCE DRAWINGS				NAME DATE DRAWN AUSTEC 02-11-2011 CHECKED TC 02-11-2011 APPROVED TC 02-11-2011 SCALE N.T.S. @ A3 ISSUE FOR INFORMATION ONLY	 DRAWING AND CONTENTS ARE COPYRIGHT TO INGAL CIVIL PRODUCTS AND CAN ONLY BE USED WITH PRIOR WRITTEN CONSENT FROM INGAL CIVIL PRODUCTS 57-65 AIRDS ROAD MINTO, N.S.W. 2566 PH. +61 2 9827 3333 www.ingalcivil.com.au	PROJECT FLEXFENCE / MASHFLEX WRSB	INGAL CIVIL PRODUCTS PART No.				
	6	29-10-2019	TITLE BLOCK UPDATED	VB	LG	LG												
	5	05-10-2016	NOTE 9 ADDED	MC	LG	LG												
	4	06-08-2016	NOTE ADDITIONS	MC	LG	LG												
	3	26-10-2012	NOTE 1 UPDATED (30MPa WAS 28MPa)	DK														
	2	02-11-2011	TITLE BLOCK UPDATED	DLB	TC	TC												
	1	12-02-2010	INITIAL ISSUE	MS	TC	TC												
	REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED											TITLE RECTANGULAR (TYPE 3) ANCHOR BLOCK	DRAWING No. WR-STD-64



1. BEFORE INSTALLATION, ENSURE THIS VARIANT OF THE MASHFLEX BARRIER IS ACCEPTED FOR USE BY THE FINAL ASSET OWNER.
2. STATE ROAD AUTHORITY SPECIFICATIONS SHOULD BE REFERENCED TO OBTAIN APPROVED POST SPACINGS AND RELEVANT MULTIPLYING FACTORS FOR INSTALLATIONS ON CURVES AND/OR VARIATIONS IN BARRIER LENGTHS (IF REQUIRED).
3. DIMENSIONS SHOWN ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
4. CABLE TENSION 25kN @ 20°C AMBIENT AIR TEMP.
5. SOIL TO MEET OR EXCEED THE REQUIREMENTS FOR AASHTO STANDARD SOIL M147-65 GRADING A OR B, OR RMS-R44 VERGE MATERIAL (Min CBR 15%, PLASTICITY INDEX: ≥ 6 AND ≤ 12).

[illegible]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

[illegible]



For more information

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