INGAL CIVIL PRODUCTS
A valmont COMPANY

ET-SS

Tangent End Terminal

Product Manual

MASH TL3 COMPLIANT

Release 12/24b

www.ingalcivil.com.au

ET-SS Tangent End Terminal

The ET-SS System Tangent End Terminal has been tested to American Association of State and Highway Transportation Officials ("AASHTO") Manual For Assessing Safety Hardware ("MASH") criteria, as a Test Level 1, 2, & 3 Guardrail End Terminal.

MASH TL1 COMPLIANT **MASH TL2** COMPLIANT **MASH TL3** COMPLIANT

This Manual must be available to the worker overseeing and/or assembling the product at all times. For additional copies, contact Ingal Civil Products directly on (02) 9827 3333 or visit www.ingalcivil.com.au.

The instructions contained in this Manual supersede all previous information and Manuals. All information, illustrations, and specifications in this Manual are based on the latest ET-SS System information available from the designers of the System to Ingal Civil Products at the time of printing. We reserve the right to make changes to this Manual at any time. Please contact Ingal Civil Products to confirm that you are referring to the most current instructions.

Important: These instructions are to be used only in conjunction with the assembly, maintenance, and repair of the ET-SS System. These instructions are for standard assemblies specified by the appropriate highway authority only. In the event the specified system assembly, maintenance, or repair would require a deviation from standard assembly parameters, contact the appropriate highway authority engineer. Ingal Civil Products representatives are available for consultation if required.

Customer Service Contacts

Ingal Civil Products is committed to the highest level of customer service. Feedback regarding the ET-SS End Terminal, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

Ingal Civil Products Corporate Contacts

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Victoria & Tasmania	(03) 9358 4100
South Australia	(08) 7081 0598

Limitations and Warnings

Trinity Highway, in compliance with AASHTO MASH, contracts with FHWA approved and accredited testing facilities to perform and evaluate crash tests in accordance with AASHTO MASH.

The ET-SS System has been deemed eligible for reimbursement by FHWA as meeting the requirements and guidelines of MASH. A component of MASH eligibility requirements include a variety of crash tests to evaluate product performance by simulating certain impact conditions involving lightweight cars (approx. 1100 kg [2420 lb.]) and full size pickup trucks (approx. 2270 kg [5000 lb.]).

The ET-SS System is tested pursuant to the test matrix criteria of MASH as designated by AASHTO and FHWA. The FHWA AASHTO tests are not intended to represent the performance of systems when impacted by every vehicle type or in every impact condition existing on the roadway. Every departure from the roadway is a unique event.

Trinity Highway expressly disclaims any warranty or liability for injury or damage to persons or property resulting from any impact, collision or harmful contact with its products, other vehicles, or nearby hazards or objects by any vehicle, object or person, whether or not the products were assembled in consultation with Trinity Highway or by third parties.

The ET-SS System is intended to be assembled, delineated, and maintained in accordance with specific state guidelines. It is the responsibility of the highway authority specifying the use of a highway product to select the most appropriate product configuration for its site specifications. A highway authority's careful evaluation of the site layout, vehicle population type and speed, traffic direction, and visibility are some of the elements that require evaluation in the selection of a highway product. For example, kerbs could cause an untested effect on an impacting vehicle.

After an impact occurs, the debris from the impact must be removed from the area immediately and the specified highway product must be evaluated and restored to its original specified condition or replaced as the highway authority determines as soon as possible. Product selection, approval, proper installation, and maintenance of any highway product is the sole responsibility of the specifying highway authority.

Safety Alert Symbols appear throughout this manual and indicate Danger, Warning, Important or Caution. Failure to read and follow these warnings could result in serious injury or death.

WARNING: Do not assemble, maintain, or repair the ET-SS System until you have read this Manual thoroughly and completely understand it. Ensure that all Danger, Warning, Caution, and Important statements within the Manual are completely followed. Please call Ingal Civil Products on (02) 9827 3333 if you do not understand any portion of these instructions or this manual.

WARNING: Safety measures incorporating appropriate traffic control devices and personal protective equipment (PPE) specified by the highway authority must be used to protect all personnel while at the assembly, maintenance, or repair site.

WARNING: Ensure that your assembly meets all appropriate Manual on Uniform Traffic Control Devices ("MUTCD") and/or local standards.

WARNING: Use only Trinity Highway or Ingal Civil parts that are specified by Trinity Highway for use with the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are other Trinity Highway systems. Such configurations have not been tested, nor have they been approved for use. Assembly, maintenance, or repairs using unspecified parts or accessories is strictly prohibited. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact with such an UNACCEPTED system.

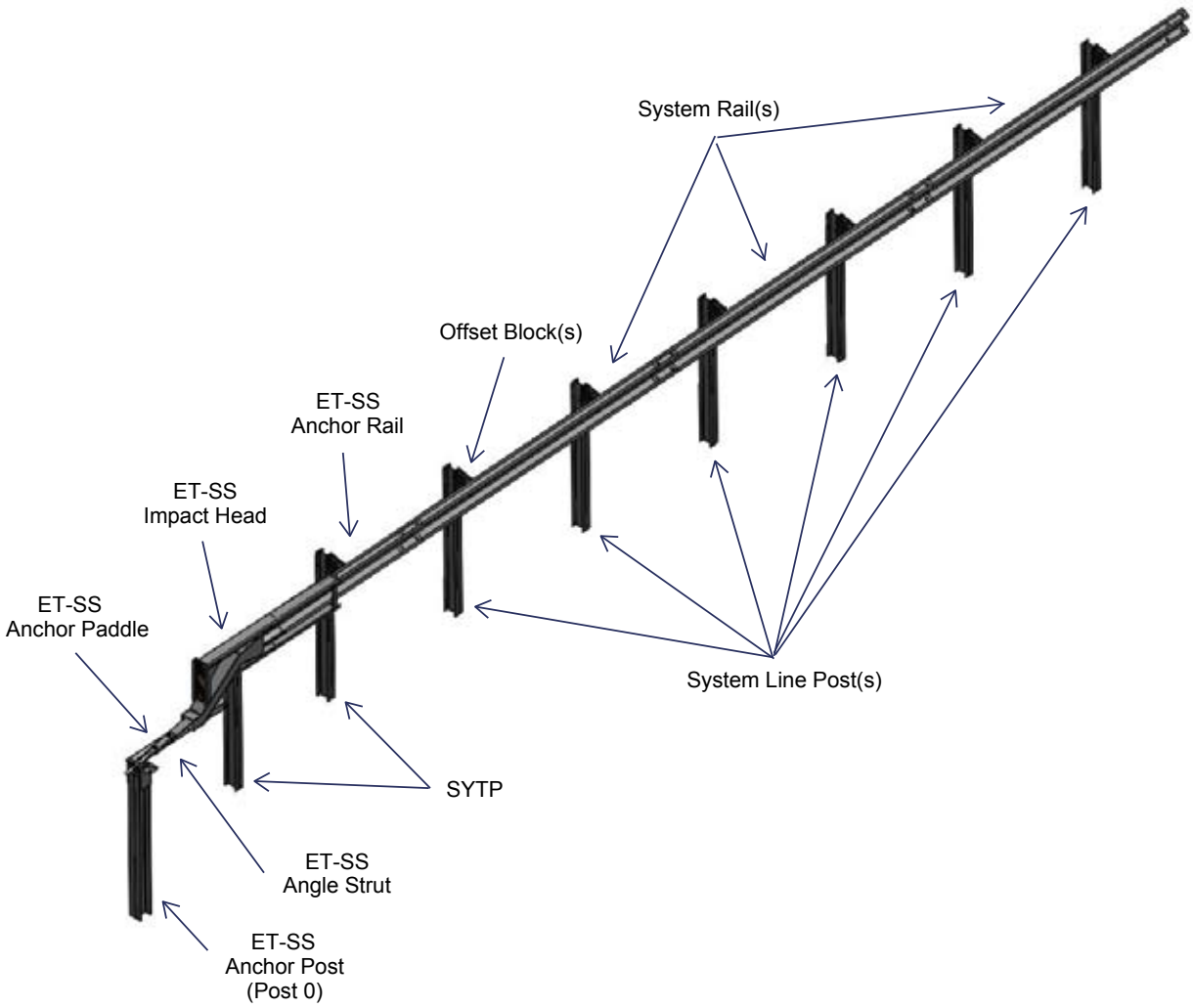
WARNING: Do NOT modify the ET-SS System in any way.

IMPORTANT: Trinity Highway makes no recommendation whether use or reuse of any part of the ET-SS System is appropriate or acceptable following an impact. It is the sole responsibility of the local highway authority and its engineers to make that determination. It is critical that you inspect the ET-SS System after assembly is complete to make certain that the instructions provided in this Manual have been strictly followed.

1.0 Introduction

The ET-SS System is a tangent, single-sided, energy-absorbing, redirective and gating end terminal system. The ET-SS System is the first end terminal to meet the evaluation criteria set forth in the AASHTO MASH. The ET-SS System is a 787 mm high (measured from top of rail to finished grade) end terminal used to shield 787 mm high post w-beam guardrail. The ET-SS System may be used to terminate post W-beam guardrail measuring between 705 mm to 787 mm with state approved transition (see Appendix for example).

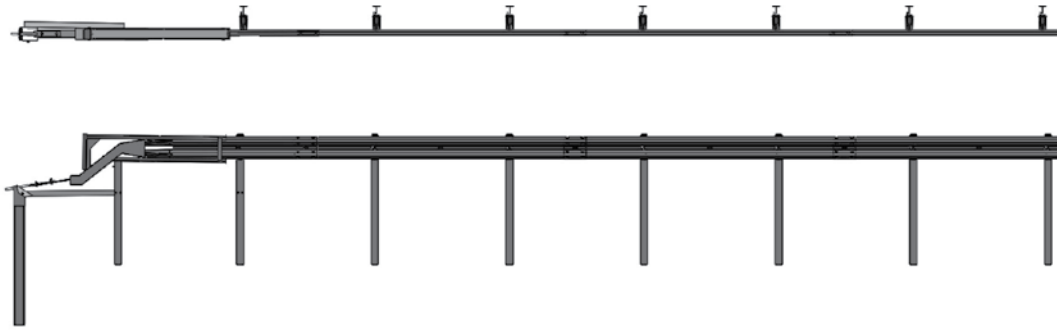
The ET-SS System contains a ET-SS Impact Head, ET-SS Anchor Rail, ET-SS Anchor Post (Post 0), ET-SS Angle Strut, two (2) Steel Yielding Terminal Posts ("SYTP®") (Posts 1 & 2) and required hardware accessories. The remaining length of the system beyond Post 2 uses System Line Posts, Offset Blocks and System Rail.



Test Level 3 configuration with 3.81m panel option shown

The ET-SS System can be assembled in a MASH Test Level 2 or Test Level 3 configuration.

ET-SS Assembly Configurations				
Test Level	**Design Speed**	**Required System Length**	**Posts**	**Point of Need**
Test Level 3	100 km/h	15.48m	Posts 0-8	Post 3
Test Level 2	70 km/h	7.86m	Posts 0-5	Post 2



Test Level 3 -15.48 m

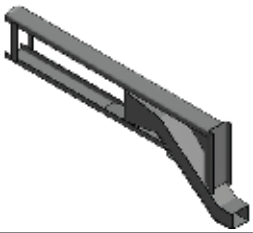
Test Level 2 -7.86 m

2.0 Inspection of Shipment

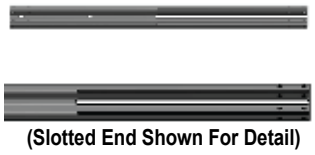
Before assembling the ET-SS System, carefully unpack and inspect all components for signs of damage. Check the received parts against the packing list supplied with the system to verify that all parts were received. If parts are damaged or missing from the shipment or unspecified parts were part of the shipment, do not attempt to assemble the system; contact Ingal Civil immediately.

All posts and rails are hot dip galvanized in accordance with AS/NZS 4680. 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 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.

ID	COMPONENT	PN	TL-3 QTY	TL-2 QTY
A	ET-SS Impact Head	10007538	1	1
B	ET-SS Anchor Rail 3.810 m	10007536	1	1
C	W-Beam Rail 3.810 m	10007537	3	1
D	ET-SS Anchor Post (Post 0)	10007543	1	1
E	ET-SS SYTP® 1460 mm	10007539	1	1
F	SYTP® Post 1830 mm	10001402	1	1
G	System Line Post 1830 mm	10007540	6	3
H	Offset King Block	10001397	7	4
I	ET-SS Anchor Paddle	10007542	1	1
K	ET-SS Keeper Plate	10007545	1	1
L	ET-SS Plate Washer	10007546	1	1
M	ET-SS Anchor Angle	10007544	2	2
N	ET-SS Angle Strut	10007547	1	1
O	M8 x 65mm Hex Bolt	10009442	2	2
P	M8 x 40mm Hex Bolt	10009441	1	1
Q	M20 x 65mm Structural Hex Bolt, Nut, Washer	10009526	2	2
R	M16 x 240mm Structural Hex Bolt, Nut, Washer	10009528	1	1
S	M16 x 45mm Structural Hex Bolt, Nut, Washer	10009525	1	1
T	M16 x 250 Post Bolt & Oversize Nut	10009787	7	4
U	M16 x 32mm Splice Bolts	10001248	32	16
V	1"Round Washer	10007548	1	1
W	M20 Structural Washer Galv	10002815	2	2
X	M16 Structural Washer Galv	10009527	2	2
Y	M8 Round Washer Wide	10009444	6	6
Z	1"Heavy Hex Nut	10007549	1	1
BB	M16 Oversize Splice Nut	10001239	32	16
CC	M8 Hex Nut	10009443	3	3
DA	ET-SS BP Anchor Bracket	10009777	n/a	1
FA	ET-SS BP SYT Post #2 813mm	10009491	n/a	1
EA	ET-SS BP SYT Post #1 440mm	10009495	n/a	1
GA	ET-SS BP Line Post #3-5 813mm	10009493	n/a	3
MA	ET-SS BP Anchor Angle	10009776	n/a	2
LA	ET-SS BP Plate Washer	10009778	n/a	1



ET-SS Impact Head
ID: A PN: 10007538



ET-SS Anchor Rail 3.810 m
ID: B PN: 10007536

System Rail 3.810 m
ID: C PN: 10007537

ET-SS Anchor Post
ID: D PN: 10007543

ET-SS SYTP 1460 mm
ID: E PN: 10007539

SYTP® 1830 mm Post
ID: F PN: 10001402

System Line Post 1830 mm
ID: G PN: 10007540

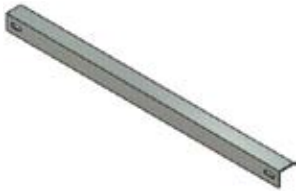
Offset King Block
ID: H PN: 10001397

ET-SS Anchor Paddle
ID: I PN: 10007542

ET-SS Keeper Plate
ID: K PN:10007545

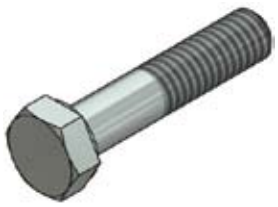
ET-SS Plate Washer
ID: L PN: 10007546

ET-SS Anchor Angle
ID: M PN: 10007544



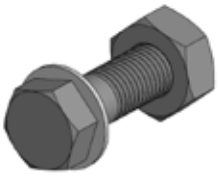
ET-SS Angle Strut
ID: N PN: 10007547

M8 x 65mm Hex Bolt
ID: O PN: 10009442



M8 x 40mm Hex Bolt
ID: P PN: 10009441

ET-SS Tangent End Terminal



M20 x 65mm Structural Hex Bolt, Nut, Washer
ID: Q PN: 10009526

M16 x 240mm Structural Hex Bolt, Nut, Washer
ID: R PN: 10009528

M16 x 45mm Structural Hex Bolt, Nut, Washer
ID: S PN: 10009525

M16 x 250 Post Bolt & Oversize Nut
ID: T PN: 10009787

M16 x 32mm Splice Bolts
ID: U PN: 10001248

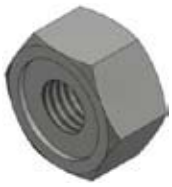
1" Round Washer
ID:V PN: 10007548

M20 Structural Washer Galv
ID: W PN: 10002815

M16 Structural Washer Galv
ID: X PN: 10009527

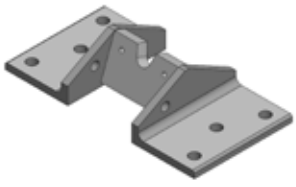
M8 Round Washer Wide
ID: Y PN: 10009444

1" Heavy Hex Nut
ID: Z PN: 10007549



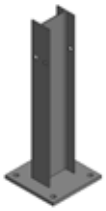
M16 Oversize Splice Nut
ID: BB PN: 10001239

M8 Hex Nut
ID: CC PN: 10009443



ET-SS BP Anchor Baseplate
ID: DA PN: 10009777

ET-SS BP SYT Post #2 813mm
ID: FA PN: 10009491



ET-SS BP Line Post 813mm
ID: GA PN: 10009493

3.0 Recommended Tools

Documentation
- Assembly Manual (Most Current Version)
- System Drawing (Most Current Version)

Personal protective equipment (PPE)
- Safety Glasses
- Work Gloves
- Safety-Toe Shoes
- Back Protection
- Hard Hat
- Reflective Vest
- Hearing Protection

Miscellaneous
- Traffic Control Equipment
- SAE Combination Wrench Set
- Socket Set & Socket Wrench
- Hammer
- Chalk Line
- Tape Measure
- Marking Paint and Pen
- Straight Edge
- Level
- Plumb Line
- Post Pounder (commonly used for driving posts)
- Auger
- Soil Tamper
- 5/8"AlignmentTool(DriftPin)
- Locking Pliers
- C-Clamps

Note: The above list of tools is a general recommendation only and should not be considered an exhaustive list.

Depending on specific site conditions and the complexity of the assembly (or repair) specified by the appropriate highway authority, additional or fewer tools may be required. Decisions as to what tools are needed to perform the job are entirely within the discretion of the specifying highway authority and the authority's selected contractor performing the assembly of the system at the authority's specified site.

4.0 ET-SS System Site Preparation

The ET-SS System is a tangent, single-sided, energy-absorbing, redirective and gating end terminal system that state/specifying agency specify for use as specified by the appropriate state/specifying authority in conjunction with W-beam guardrail on the shoulder or median of a roadway. The decision to specify the ET-SS System for a particular project is the responsibility of the state/specifying agency design engineer who must ensure that the most appropriate end terminal has been selected for the specific site conditions.

Important: Do not attach the ET-SS System directly to a rigid barrier (i.e. concrete barrier, wall or bridge pier) without the use of a state/specifying agency approved transition.

Important: Ensure that the ET-SS System assembly conforms to the local road design standards.

Important: Ingal Civil Products does not direct grading. Proper site grading must be accomplished before assembly of the ET-SS System in accordance with road controlling guidelines and requirements. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact or collision.

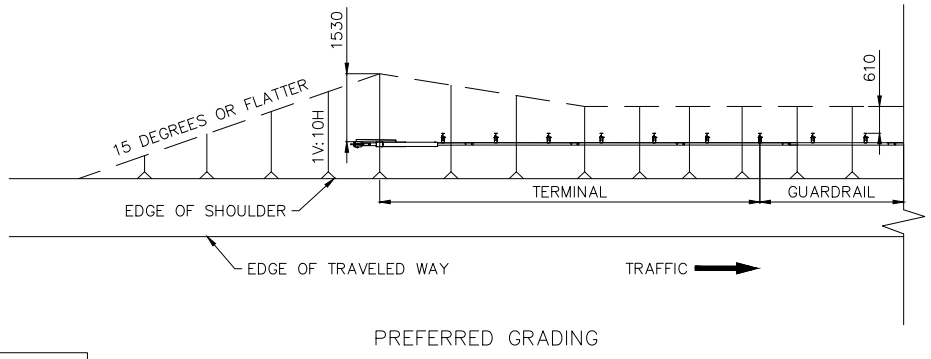


Figure 1: Preferred Grading (not to scale)

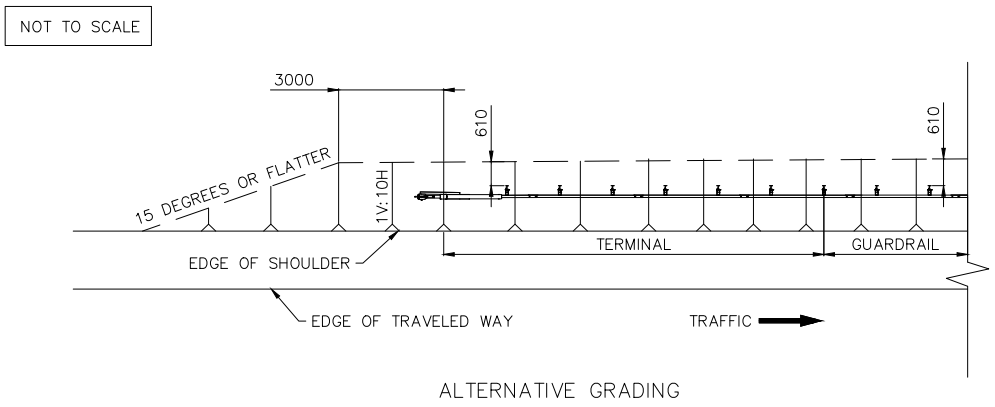


Figure 2: Alternative Grading (not to scale)

5.0 ET-SS System Offset Requirements

The ET-SS System is a tangent guardrail end treatment that is assembled parallel to the edge of shoulder. At the sole discretion of the state/specifying agency design engineer, the ET-SS System may be offset away from the shoulder over the length of the entire system (from centre of last splice location of ET-SS System to center of Post 0) per the following designer approved offsets:

Test Level 1 (TL-1)	Test Level 2 (TL-2)	Test Level 3(TL-3)
152 mm Maximum	305 mm Maximum	610 mm Maximum

Caution: Under no circumstances shall the rail within the ET-SS System be curved.

5.1 Offset Requirements Within A Curve

When the guardrail is terminated within a curve (convex or concave) and a ET-SS System is attached, the following instructions must be followed to ensure proper offset requirements within a curve for the ET-SS System are met. If the conditions below cannot be achieved, it is recommended that the guardrail be extended past the curve until the conditions can be met. The offset requirements in a curve are calculated for the TL-3 ET-SS System. If assembling a TL-1 or TL-2 ET-SS System, an overall straight length of 15.48 m must be obtained (ET-SS System + W-Beam Guardrail) for calculating offset requirements in a curve.

Note: Using an offset closer to 0 m on tighter curves (radii) will cause the terminal to encroach on to the shoulder.

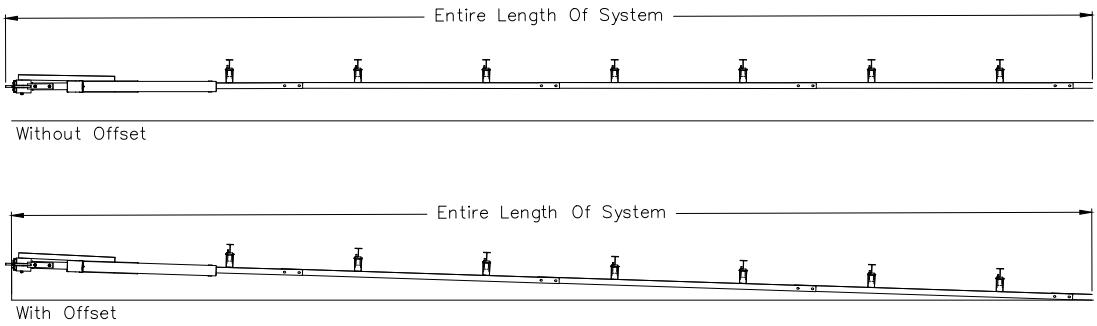


Figure 3: Entire Length of System

5.2 Convex Curve

For radii of 198 m or greater (flatter), the offset is 0 m to 610 mm.

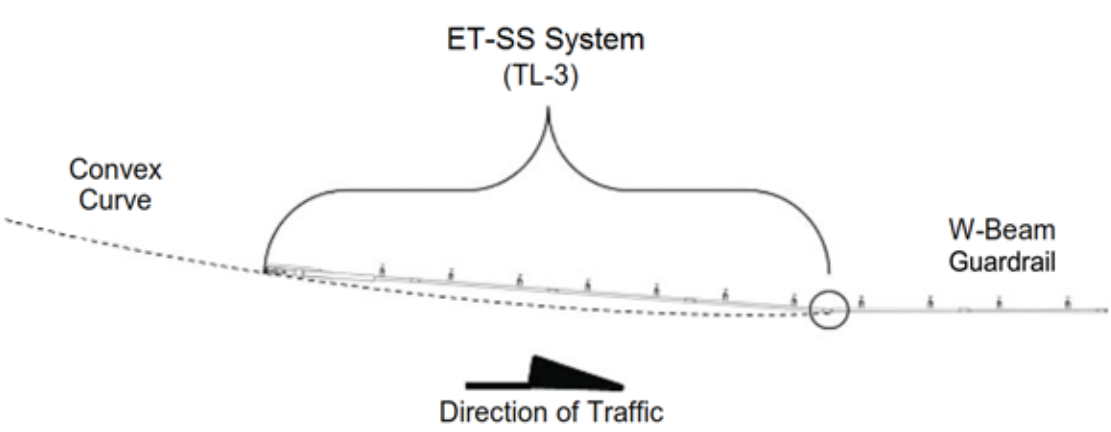


Figure 4: Convex curve

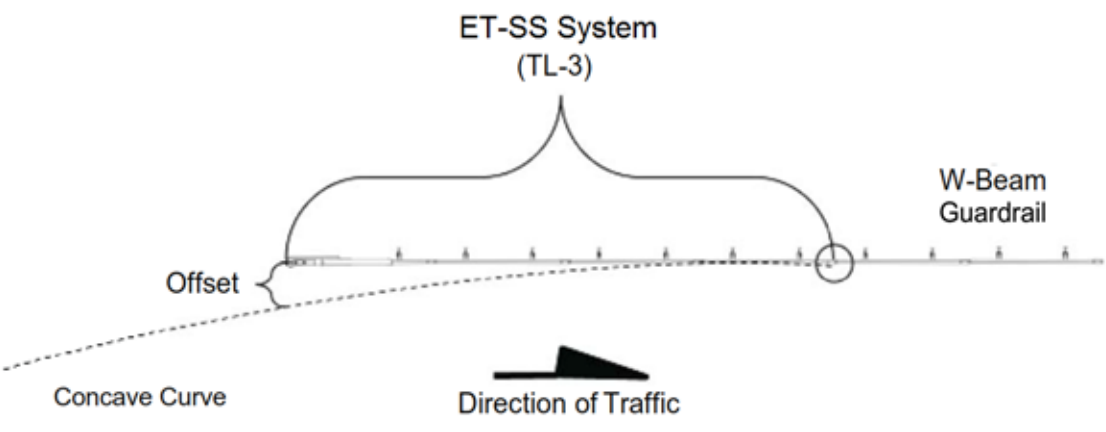


Figure 5: Concave curve

6.0 ET-SS System Post Placement

Danger: Ensure all above & below ground utilities are located, marked and identified prior to using auger or post driving equipment in accordance with local specifying agency guidelines. Failure to follow this warning could result in serious injury or death.

6.1 Determine Post Locations

Place a level or straight edge on the face of downstream guardrail (i.e. traffic side) to the finished grade to create a reference line for face of guardrail. The reference line will be used to determine post location for the last post of the ET-SS System.

The last post of the ET-SS System will be located 272 mm from face of downstream guardrail to back of the last post of the ET-SS System to accommodate an 190mm offset block and be spaced 1905 mm (typical) on center from the first post of the W-beam system (see drawing below). Refer to the post placement diagrams in this manual for remaining post locations.

The ET-SS System posts may be inserted into the soil using an auger or impact hammer pile driver used for the placement of guardrail posts. If an auger is used, ensure diameter is large enough to allow for proper compaction of agency approved fill material. All ET-SS System posts are to be assembled plumb. Proper compaction must be accomplished for all posts in accordance with state/ specifying agency guidelines.

If rock is encountered at post locations 2-8, refer to the local specifying agency guidelines and the AASHTO Roadside Design Guide for requirements for embedment depth into the rock and size of the hole. If rock is encountered at post locations 0-1, auger a hole in the rock large enough for full post embedment and proper compaction of approved fill material.

If rigid pavement (e.g. concrete or asphalt) of any thickness is encountered at post locations 0-8, ensure a proper "leave-out" area is provided around the posts , refer Figures 6 and 7. This is filled with road controlling agency approved backfill material.

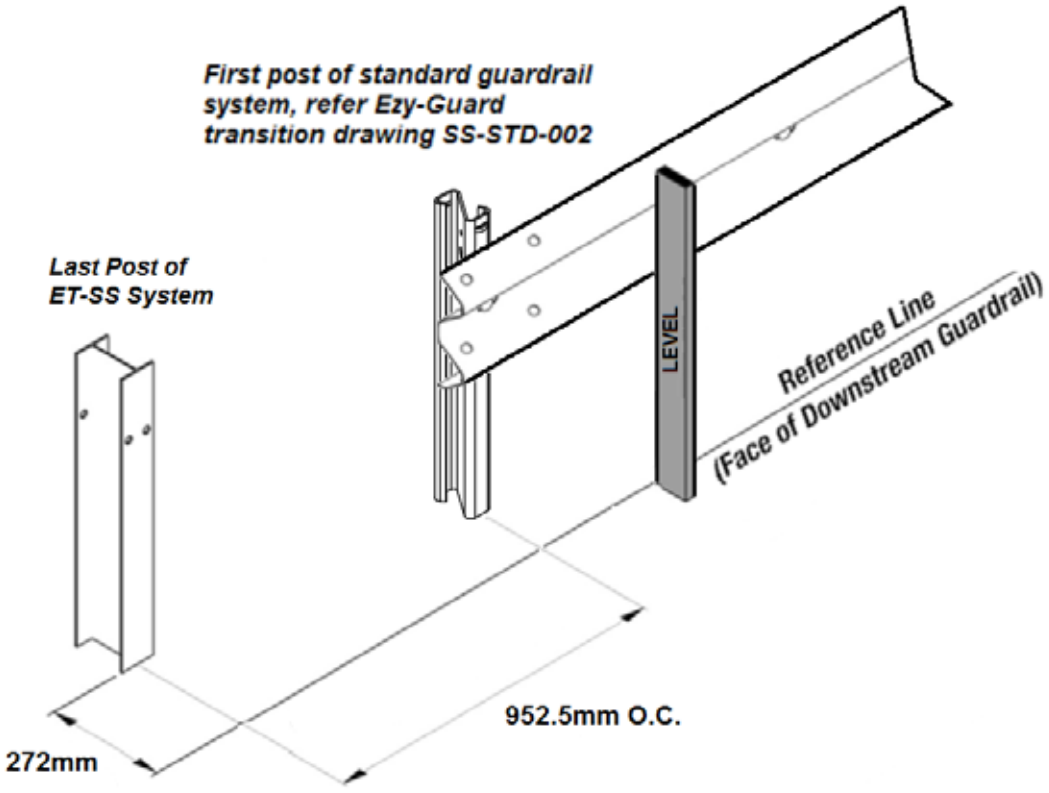


Figure 6: Post locations

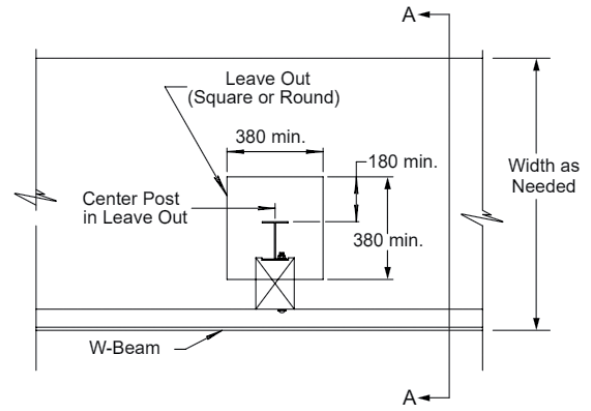


Figure 7: Steel Post Detail

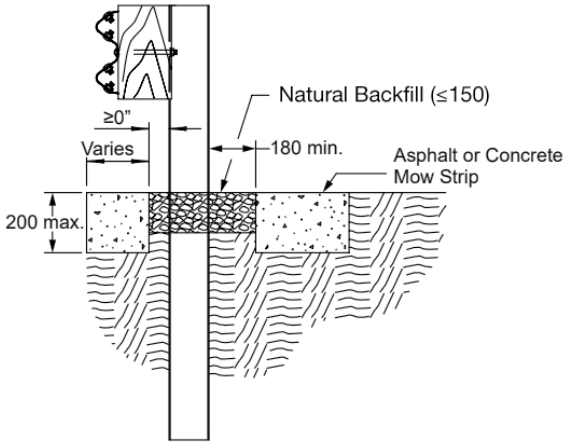


Figure 8: Section A-A

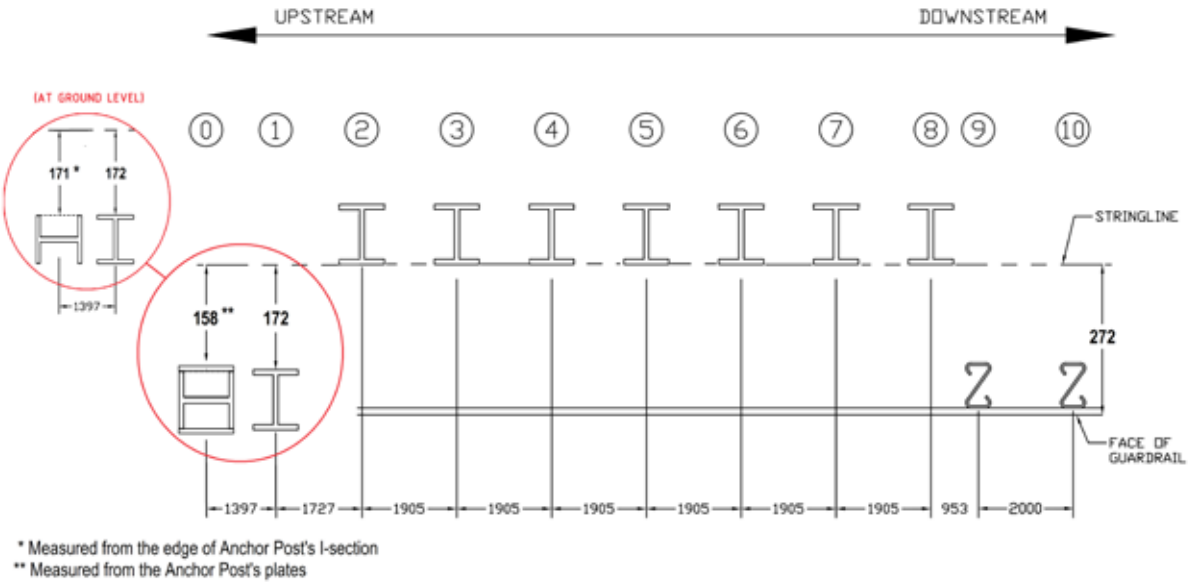


Figure 9: ET-SS System (Test Level 3) – Post Placement Diagram

Notes:
1. Post 0-8 part of ET-SS System TL3
2. Post 9 is first post of longitudinal w-beam system (not included with ET-SS System)
3. Spacing between posts is on centre as shown
4. All ET-SS System posts must be installed plumb
5. Guardrail splice joint located at Post 9

6.2 ET-SS System Anchor Post (Post 0) Placement

The ET-SS System Anchor Post (10007543) is the first post of the ET-SS System and is designated as Post 0. The ET-SS System Anchor Post is made from W6 x 15 I-beam sections and is to be assembled plumb and oriented with the front side of post facing towards the upstream end.

A. When assembled to the correct depth, the ET-SS System Anchor Post stub will protrude 89 mm above the finished grade line (see Step 2 of this Assembly Manual).

B. When fully assembled, the ET-SS System Anchor Post (with Anchor Angles) will protrude 102 mm above the finished grade line (see Step 12 of this Assembly Manual).

If rock is encountered when driving the anchor post, a range of alternative concrete footings are available on drawing SS-STD-010. Depending on the depth of the chosen option, the post will need to be cut to suit. A corrosion resistant treatment shall be applied to the freshly cut surface, ICP recommend a Zinc metal spray in accordance with ISO 2063 or AS/NZS 2312. Installation of this variant should be accompanied by a site specific ground investigation, refer asset owner acceptance conditions.

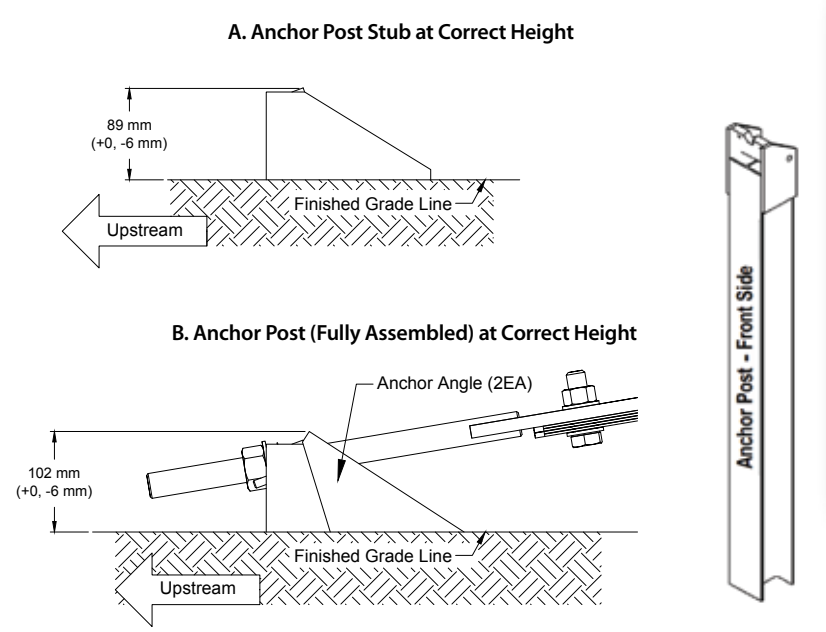
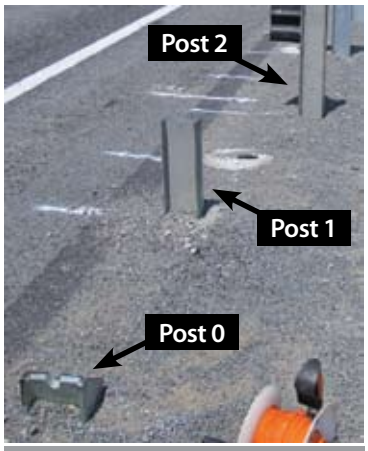


Figure 10: Anchor Post (Post 0) placement



Relative Post Heights

Note: For installations where the barrier is being installed in close proximity to the edge of seal and the verge gradient is resulting in the terminal posts being installed high relative to the local ground, additional site grading should be considered.

If this is not possible, the Anchor Post should be installed in accordance with Figure 10. Posts 1 and 2 will also require their height to be adjusted to suit the assembly of the terminal.

6.3 ET-SS System Impact Head

The ET-SS Impact Head (10007538) component is symmetrical and can be assembled on the left or right shoulder. The diagram below lists some of the subcomponents of the Impact Head.

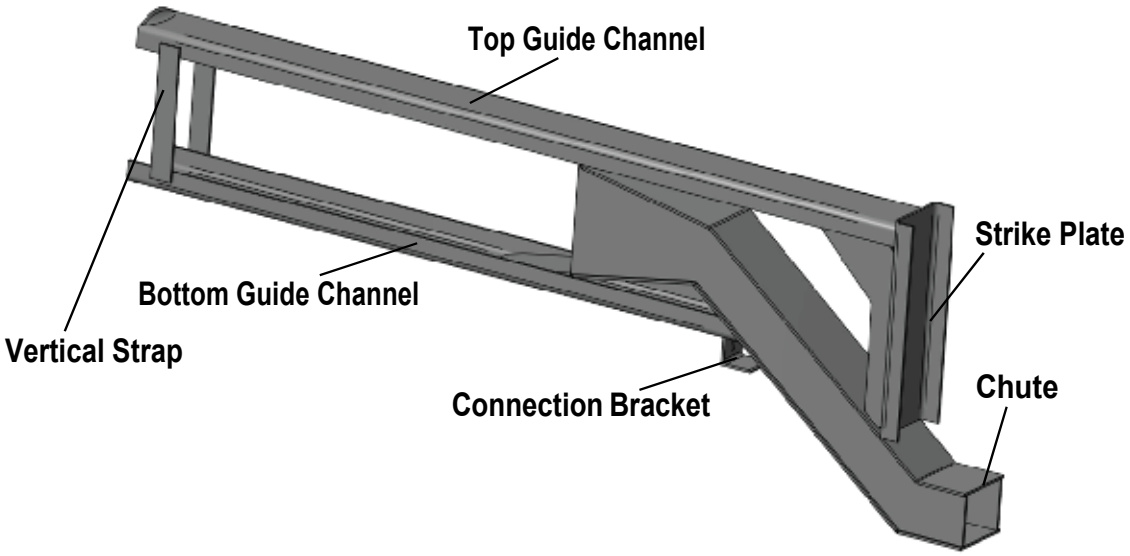


Figure 11: ET-SS System Impact Head

When properly assembled, the ET-SS Impact Head shall only be assembled parallel to the finished grade line or have an upward tilt (towards front of the system). The elevation of the Impact Head should be relatively levelled between Point A and Point B. Point A is measured from the finished grade line to where the corner of the side plate connects with the top guide channel and Point B is measured from the finished grade line to where the inside corner of the vertical strap connects with the top guide channel.

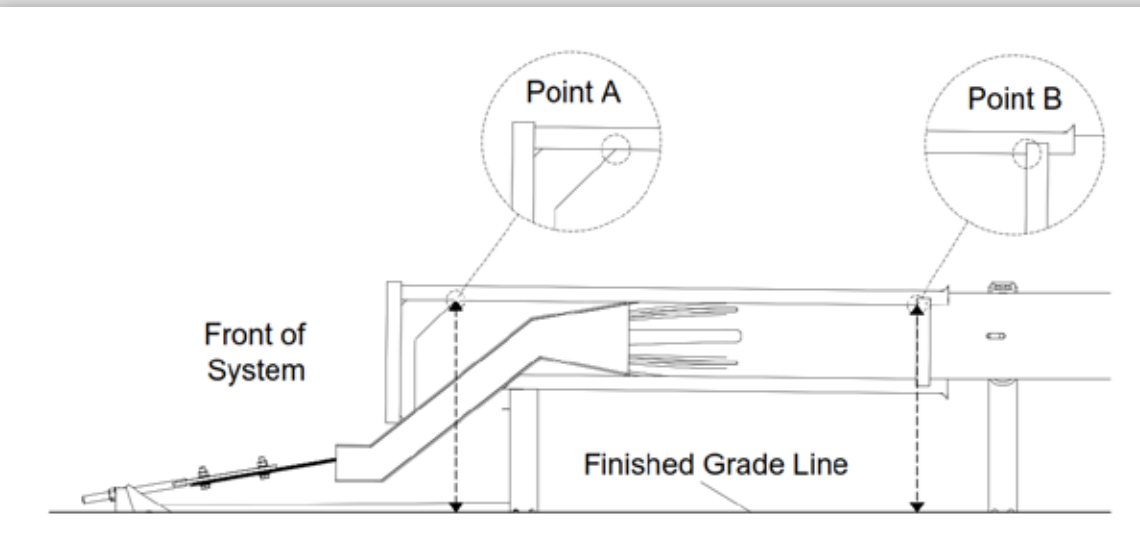
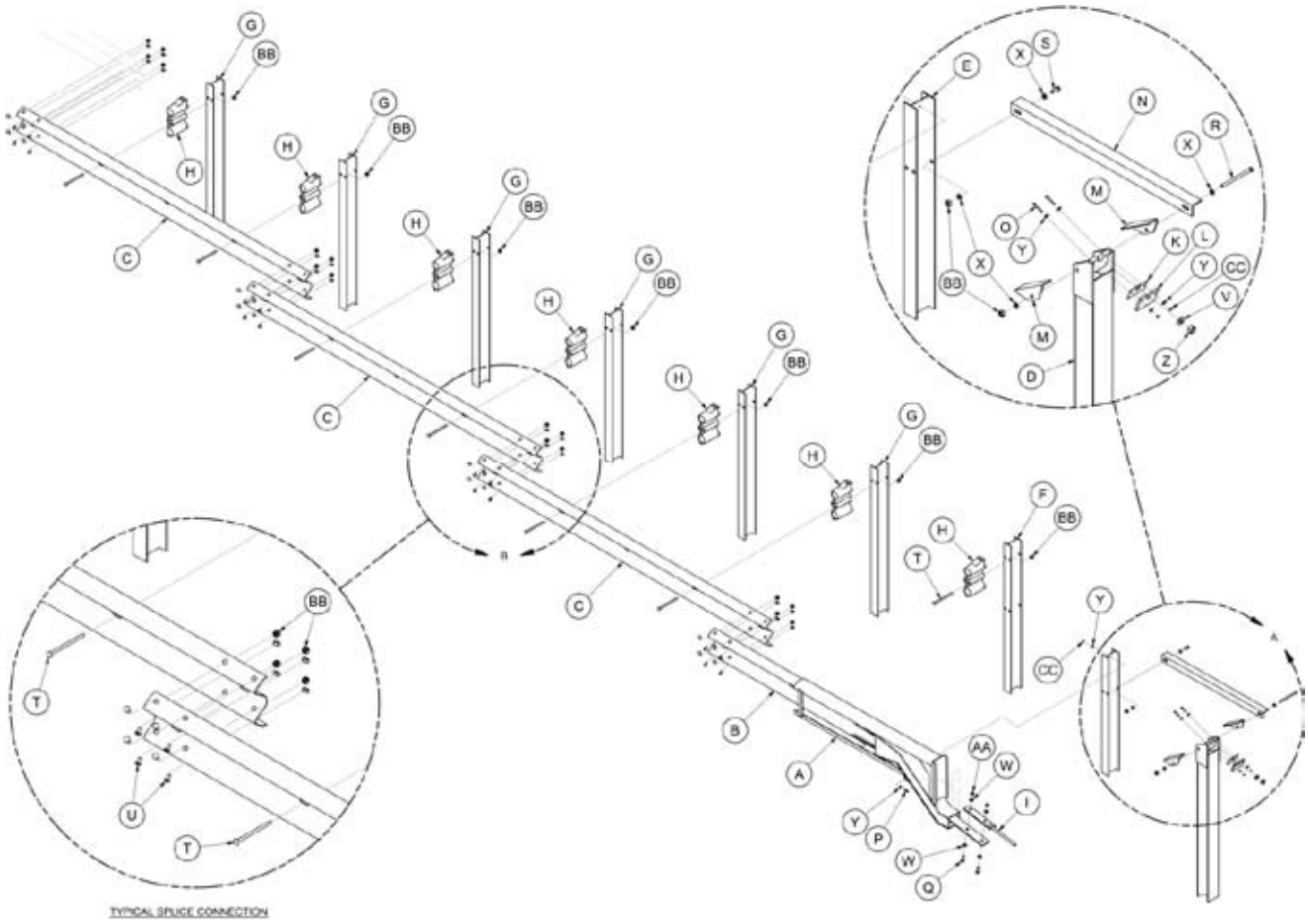


Figure 12: Correct assembly of the ET-SS Impact Head

7.0 TEST LEVEL 3 ASSEMBLY STEPS

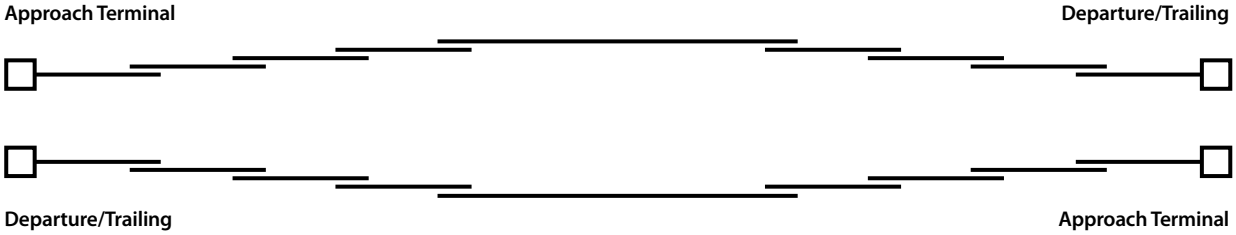
Important: Always use safety precautions when performing assembly, maintenance, repair and/or moving heaving equipment. Ensure proper personal protective equipment (PPE) is worn. Failure to follow this warning could result in serious injury or death.



7.1 TERMINAL RAIL LAPPING

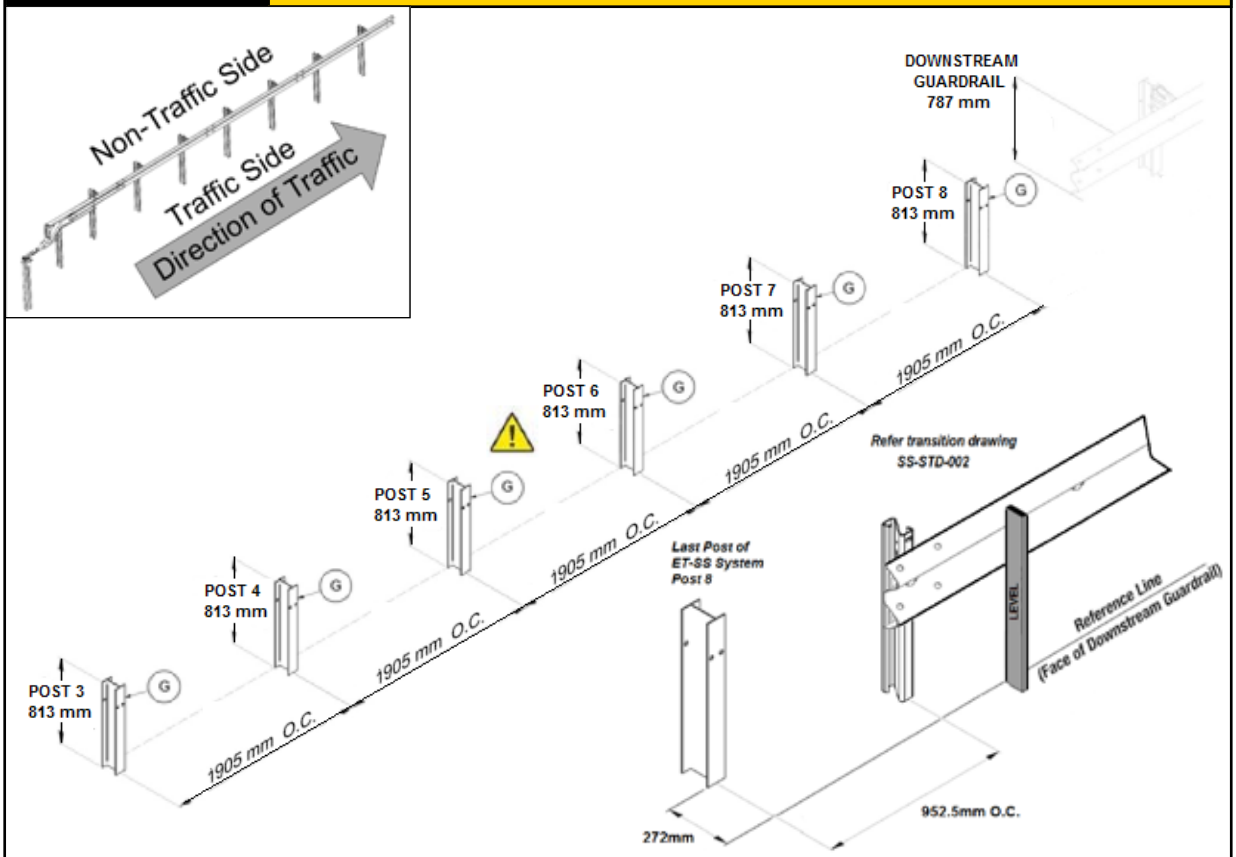
The ET-SS End Terminal has been designed so that WBeam Rail with Splice Bolts may pass through the head regardless of Rail Lapping Orientation. ASBAP Technical Note SBTA 17-001 recommends that terminal rails be lapped in the direction of impacting traffic. This treatment applies to the whole of length of the terminal and it's splice joints.

All ET-SS End Terminals should be lapped as per below regardless of traffic direction or whether used as approaches or departures (trailing terminals).



8.0 INSTALLATION PROCEDURE

STEP 1 TL3 System Line Post Assembly (Posts 3-8)



PARTS		
G	10007540	6 EA

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

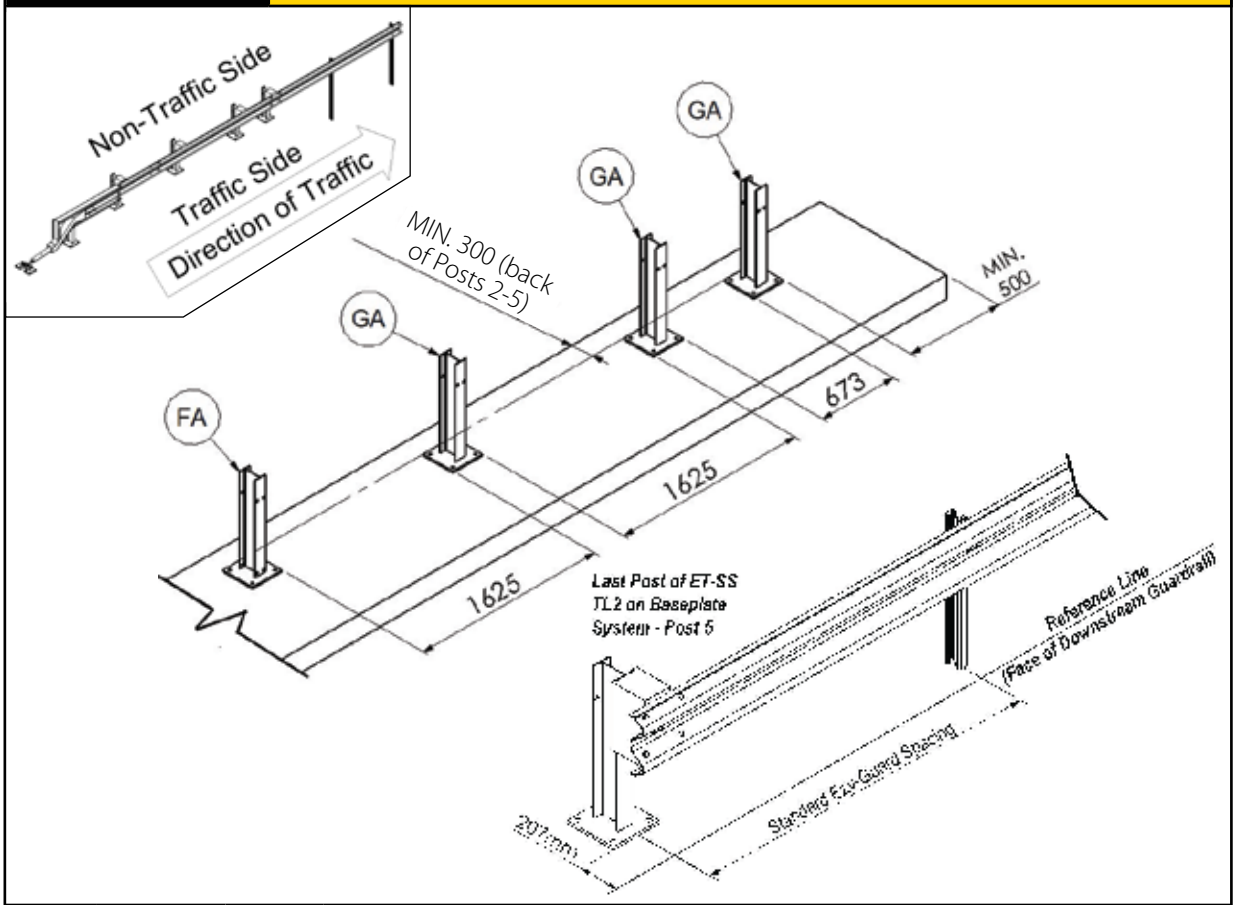
INSTRUCTIONS

1. Assemble all parts in the configuration & orientation as shown in the above diagram.
2. The ET-SS System must be attached to a w-beam guardrail that has been properly transitioned to 787 mm rail height per state/specifying agency (see Appendix for transition drawing example).
3. Establish the location of the last post of the ET-SS System (Post 8) by placing a level on the face of downstream guardrail to the finished grade and applying offset and post spacing requirements shown above.
4. Ensure proper post spacing and post height is achieved for Posts 3-8 (Part G) per shown dimensions above.

WARNINGS

Proper site grading must be accomplished in accordance with local specifying agency guidelines. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact or collision with the system.

STEP 1A Baseplated System Post Assembly – TL2



PARTS		
GA	10009493	3 EA
FA	10009491	1 EA

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

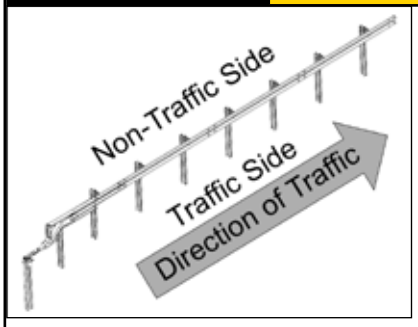
INSTRUCTIONS

1. Assemble all parts in the configuration & orientation as shown in the above diagram.
2. The ET-SS System must be attached to a w-beam guardrail that has been properly transitioned to 787 mm rail height per state/specifying agency (see Appendix for transition drawing example).
3. Establish the location of the last post of the ET-SS System (Post 5) by placing a level on the face of downstream guardrail to the finished grade and applying offset and post spacing requirements shown above.
4. Ensure proper post spacing and post height is achieved for Posts 0-5.
5. To be read in conjunction with ET-SS drawing SS-STD-011.

WARNINGS

Proper site grading must be accomplished in accordance with local specifying agency guidelines. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact or collision with the system.

STEP 2 Post Assembly (Posts 0-2)



PARTS		
F	10001402	1 EA
E	10007539	1 EA
D	10007543	1EA

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

INSTRUCTIONS

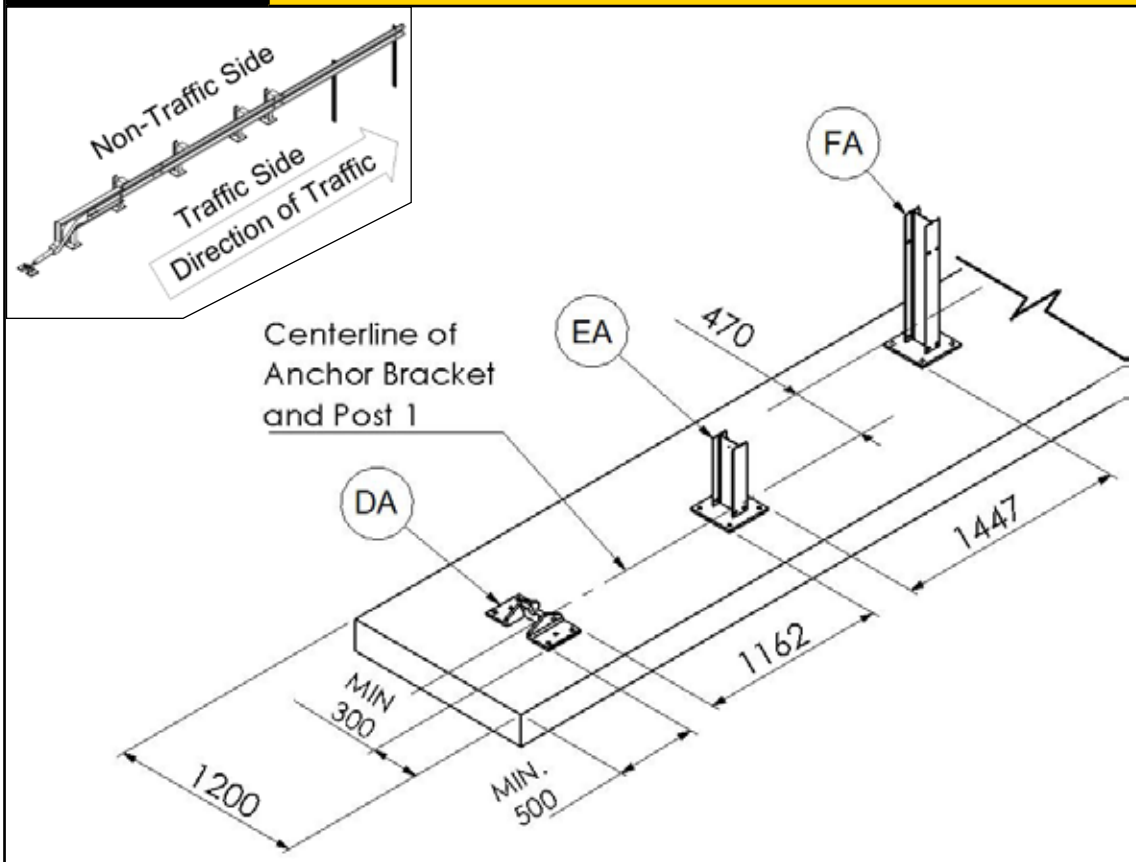
1. Assemble all parts in the configuration & orientation shown above.
2. Ensure proper offset for Post 0 (Part D) and Post 1 (Part E) is as shown on dimension above and on the Post Displacement Diagram (page 30).
3. Ensure center of yielding holes for Post 1 & 2 are approximately at finished grade, as shown.
4. Ensure Post 0 stub height does not exceed 89 mm above finished grade.
5. Ensure proper post spacing and post height is achieved per shown dimensions above.

WARNINGS

Proper site grading must be accomplished in accordance with local road authority guidelines. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact or collision with the system.

Refer to section 6.2 for grading requirements.

STEP 2A Post Assembly (Posts 0-2)



PARTS		
FA	10009491	1 EA
EA	10009495	1 EA
DA	10009777	1EA

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

INSTRUCTIONS

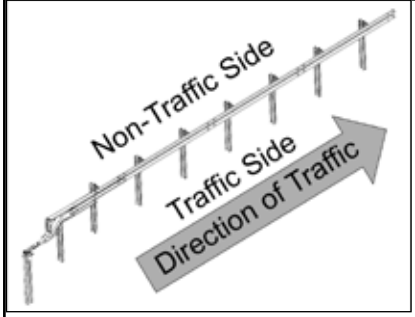
1. Assemble all parts in the configuration & orientation shown above.
2. Ensure proper offset for Post 0 (Part D) and Post 1 (Part E) is as shown on dimension above and on the Post Displacement Diagram (page 30).
3. Ensure SYT posts are used for locations 1 and 2.
4. Ensure proper post spacing is achieved per shown dimensions above and drawing SS-STD-011.
5. Ensure posts have been anchored in accordance with drawing SS-STD-011.

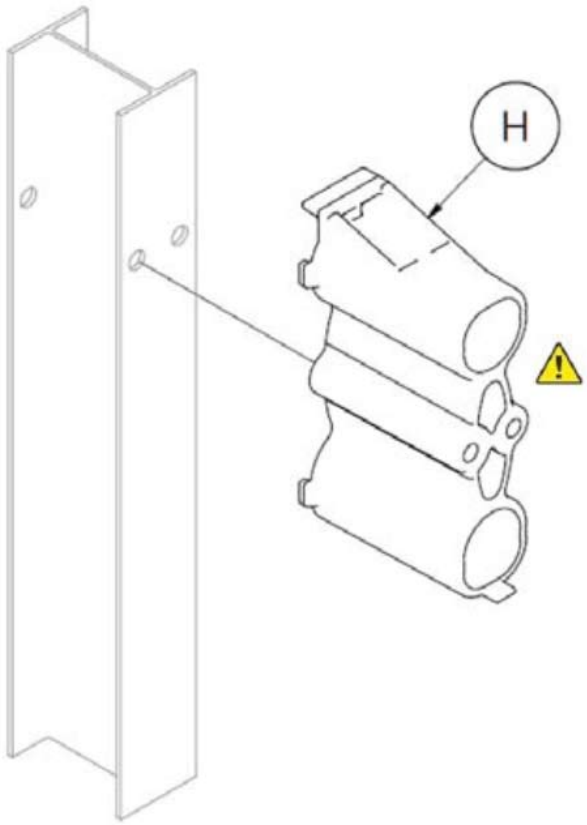
WARNINGS

Proper site grading must be accomplished in accordance with local road authority guidelines. Failure to follow this warning could result in serious injury or death in the event of a vehicle impact or collision with the system.

Refer to section 6.2 for grading requirements.

STEP 3 Offset Block Assembly (Posts 3-8)





PARTS		
H	10001397	6 EA

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

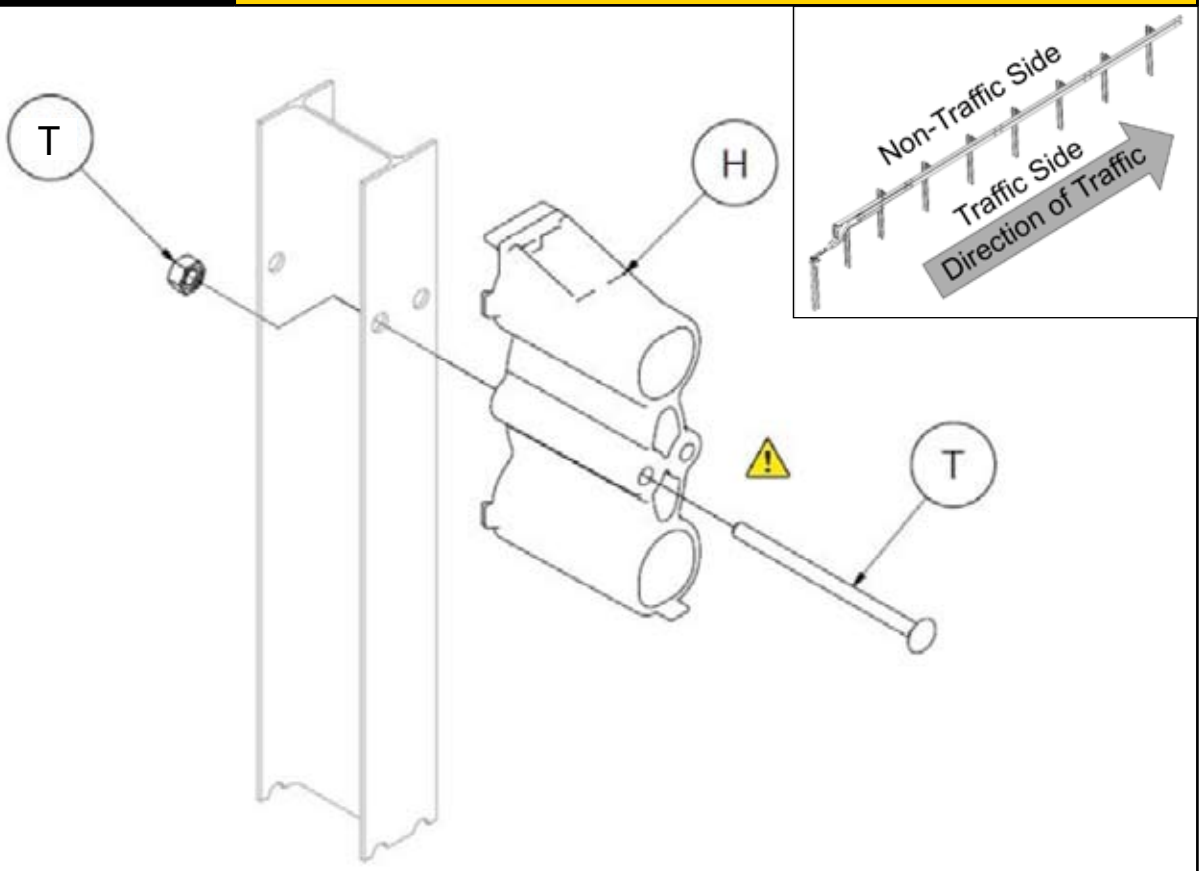
INSTRUCTIONS

1. Assemble all parts in the configuration & orientation shown above.
2. Attach (1 EA) Offset Block (Part H) on traffic side of Posts 3-8. The Offset Block is equipped with a self-hanging mounting tab.

WARNINGS

Do not use any Offset Block (Part H) if they show signs of damage. Seek replacement from Ingal Civil Products prior to assembly.

STEP 4 Offset Block Assembly (Post 2)



PARTS		
H	10001397	1 EA
T	10009787	1 EA

INSTRUCTIONS

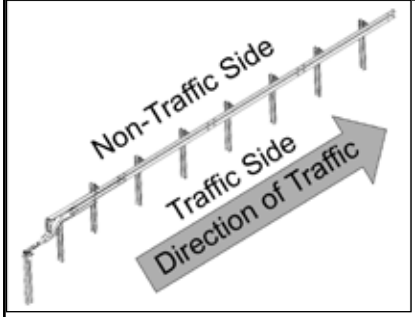
1. Assemble all parts in the configuration & orientation shown above.
2. Attach (1 EA) Offset Block (Part H) on traffic side of Post 2. The Offset Block is equipped with a self-hanging mounting tab.
3. Secure Offset Block to post with shown hardware.
4. Tighten all threaded hardware to a snug position with an appropriately sized wrench or socket.

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

WARNINGS

Do not use any Offset Block (Part H) if they show signs of damage. Seek replacement from Ingal Civil Products prior to assembly.

STEP 5 — 3.81m System Rail Assembly (Post 3-8)



PARTS		
C	10007537	3 EA
T	10009787	6 EA
U	10001248	24 EA
BB	10001239	24 EA

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

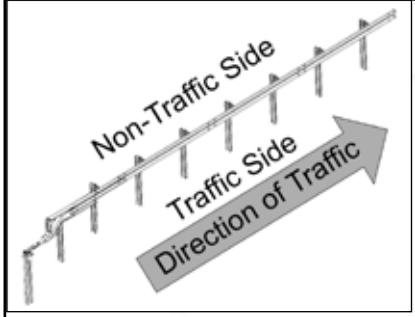
INSTRUCTIONS

1. Place all System Rail Panels (Part C) on the traffic side of the posts and lap in the direction as shown in Section 7.1 (page 16) using hardware shown above.
2. Tighten all threaded hardware to a snug position with an appropriately sized wrench or socket.

WARNINGS

Do not place anything between any post bolt head and the ET-SS System Rail that would prevent the bolt from pulling through (i.e. no rectangular washers or delineators). Failure to follow this warning could result in serious injury or death in the event of a collision.

STEP 6 Anchor Rail Assembly



PARTS		
B	10007536	1 EA
U	10001248	8 EA
BB	10001239	8 EA

INSTRUCTIONS

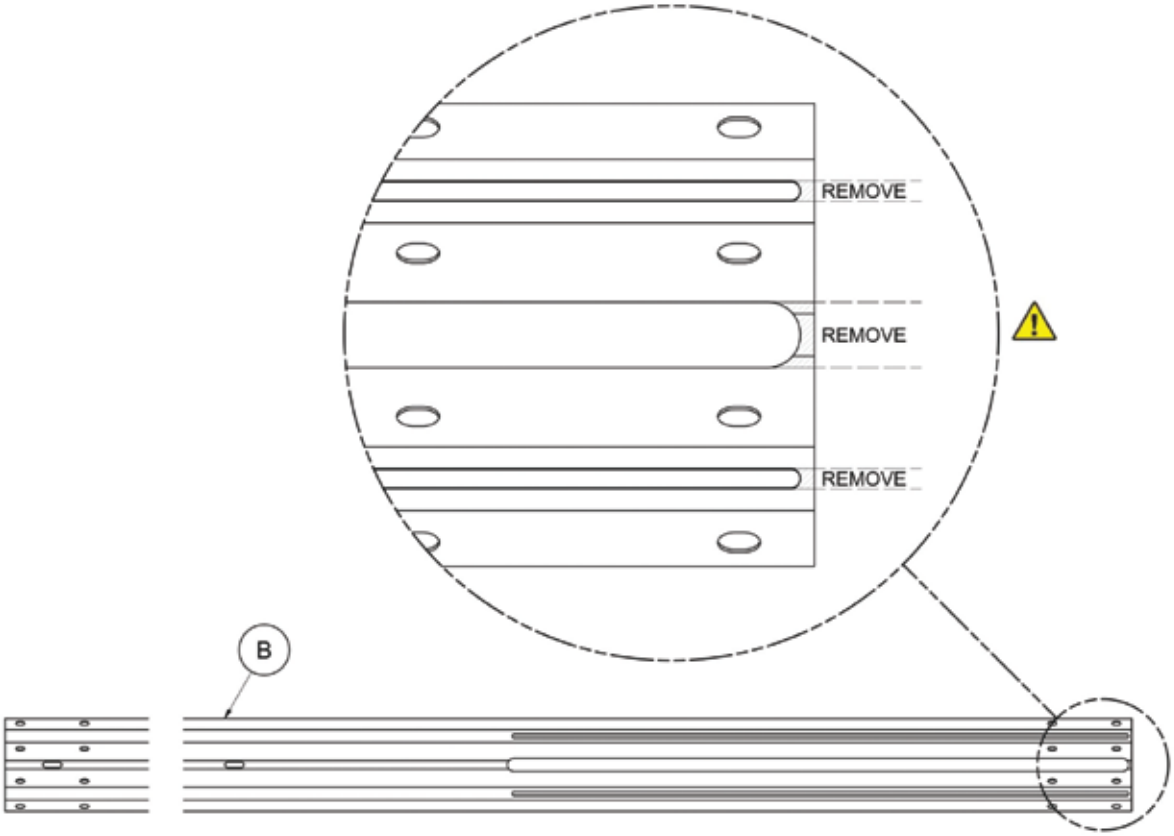
1. Install ET-SS Anchor Rail (Part B) and lap in the direction as shown in Section 7.1 (Page 16).
2. Tighten all threaded hardware to a snug position with an appropriately sized wrench or socket.

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

WARNINGS

Do not bolt the ET-SS Anchor Rail to Post2. Failure to follow this warning could result in serious injury or death in the event of a collision.

STEP 7 Anchor Rail Shipping Tabs Removal



PARTS		
B	10007536	1 EA

INSTRUCTIONS

1. The ET-SS Anchor Rail is manufactured with three (3) shipping tabs. These shipping tabs can be removed with an abrasive blade cutting device or bolt cutters to assist in the assembly process.
2. Cut the three (3) shipping tabs with six (6) straight cuts Step 7 Assembly Tip: For efficiency, make the bottom cut first, moving up the ET-SS Anchor Rail to the top cut.

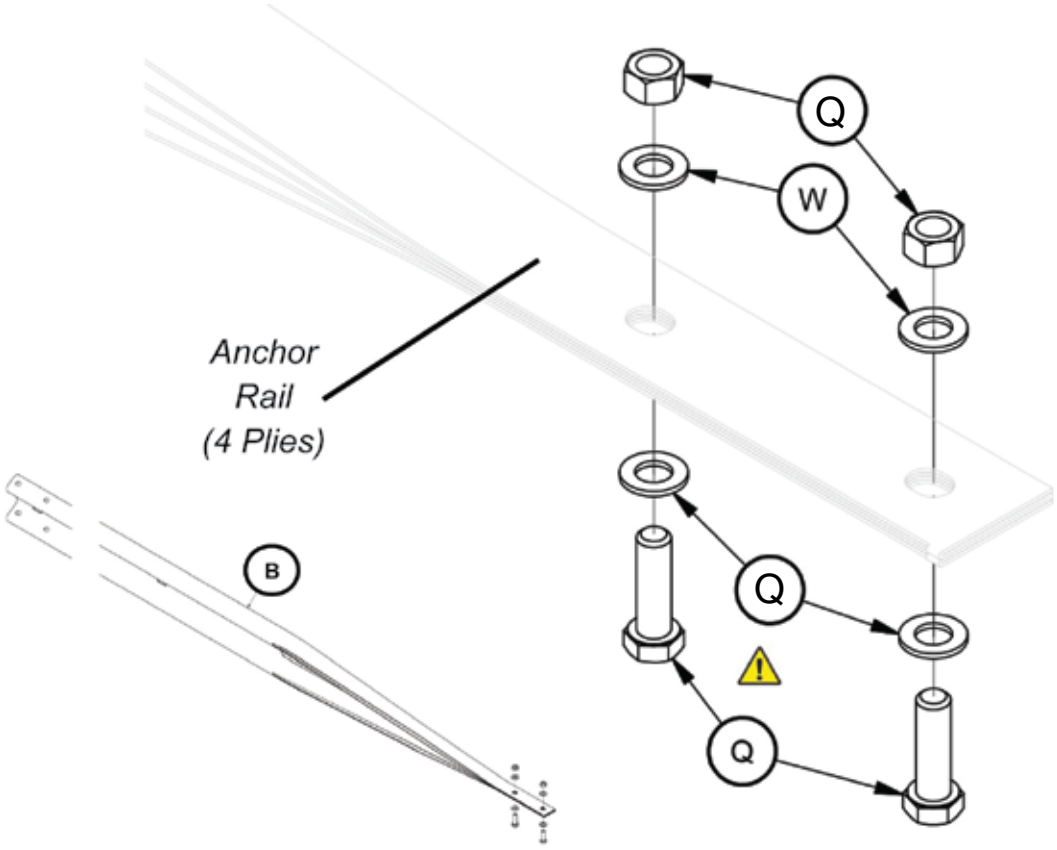
Note: It is NOT required to remove the shipping tabs. It is permissible to assemble the Anchor Rail with flattened tabs, should the contractor desire to do so.

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

WARNINGS

Keep body parts clear of abrasive blade cutting device. Ensure proper personal protective equipment (PPE) is worn. Failure to follow this warning could result in serious injury or death.

STEP 8 Anchor Rail Hardware Assembly



PARTS		
B	10007536	1 EA
Q	10009526	2 EA
W	10002815	2 EA

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

INSTRUCTIONS

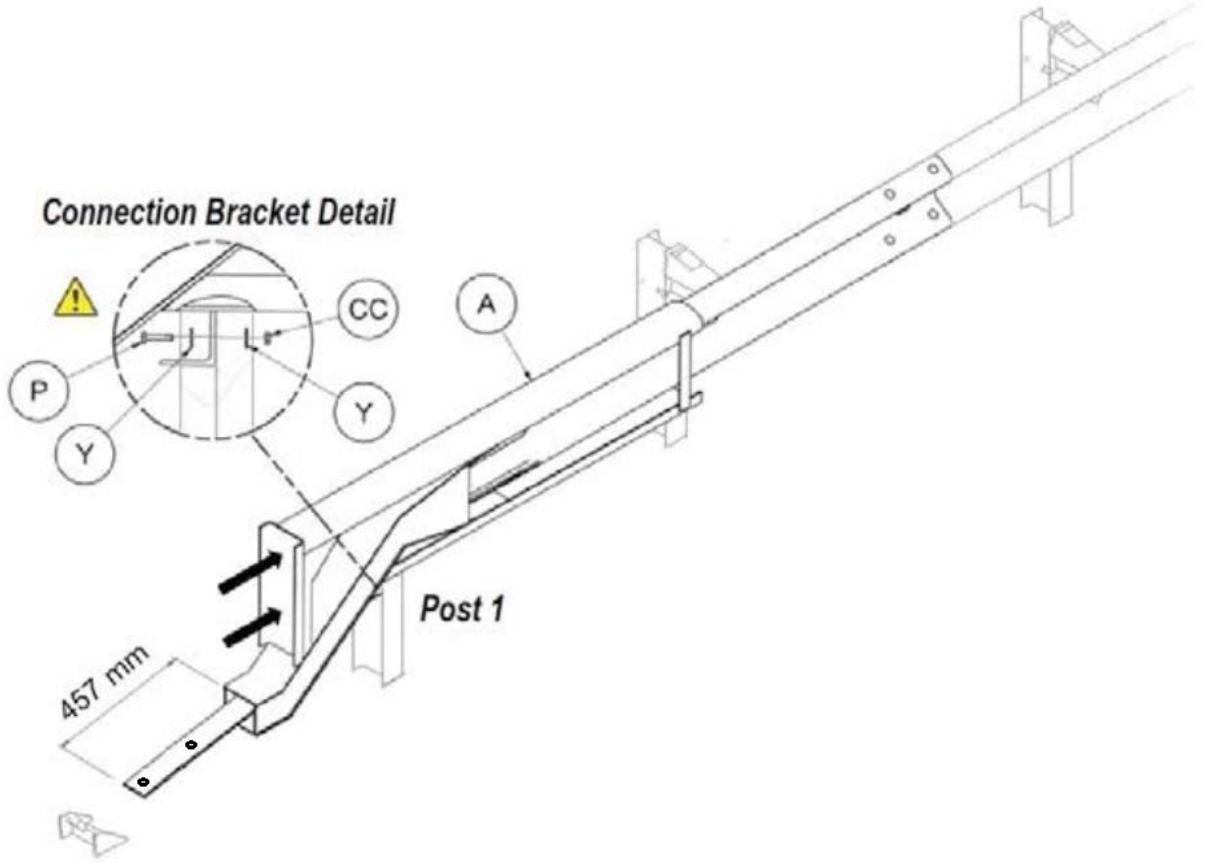
1. Assemble all parts in the configuration & orientation shown above.
2. Insert both hex bolts (Part Q) through the bottom side of the four (4) plies of the ET-SS Anchor Rail (Part B). The bottom side is determined by the final assembled position on the ET-SS System. The use of locking pliers or C-clamps is recommended to aid the assembly process.
3. It is recommended the hardware be tightened fully to allow the rail to be flattened completely by the hardware; the nuts and washers will be removed and reinstalled in Step 10.

Note: Only one (1) ET-SS Anchor Rail is used per assembly.

WARNINGS

Insert the ET-SS Anchor Paddle Bolts (Part Q) from the bottom of the ET-SS Anchor Rail. Failure to follow this warning could result in serious injury or death in the event of a collision.

STEP 9 Impact Head Assembly



PARTS		
A	10007538	1 EA
P	10007553	1 EA
Y	10009444	2 EA
CC	10009443	1EA

INSTRUCTIONS

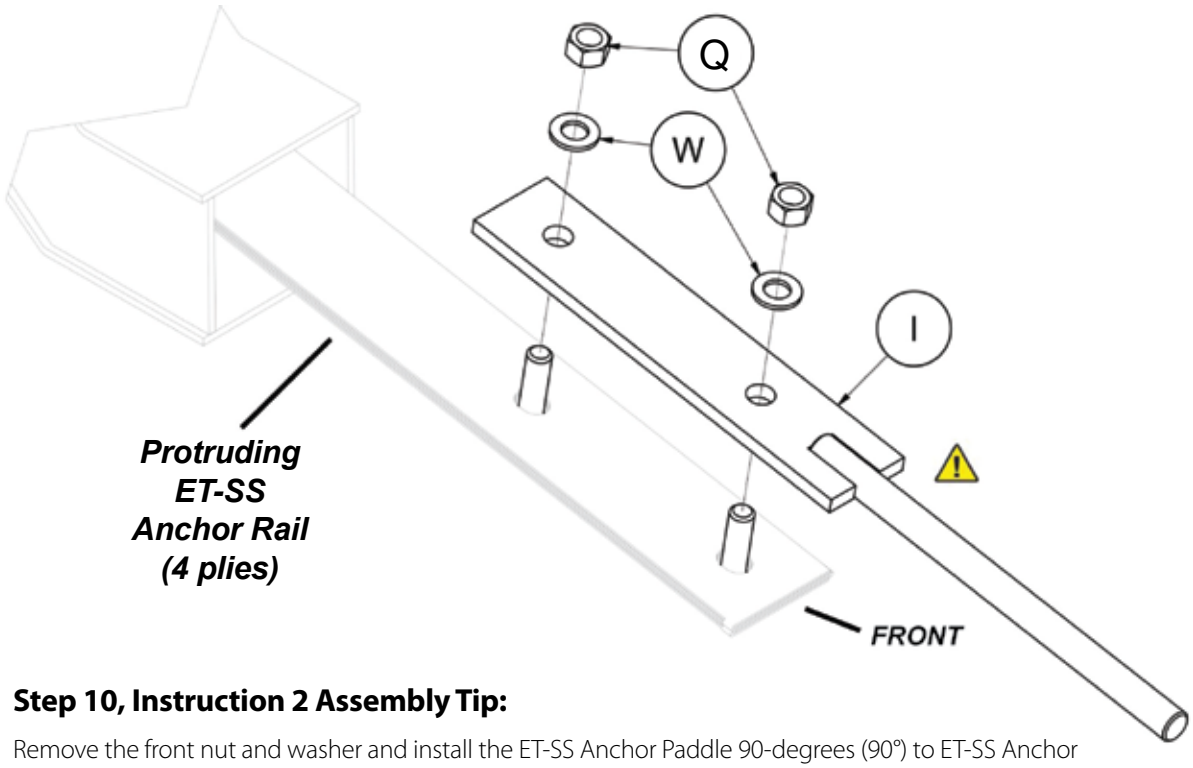
1. Assemble all parts in the configuration & orientation shown above.
2. Mechanically push the ET-SS Impact Head (Part A) until its Connection Bracket rests against Post 1 and a minimum 457 mm of the ET-SS Anchor Rail is protruding out the Chute.
3. Fasten Post 1 and the Connection Bracket together with shown hardware (Parts P, Y, & CC) and tighten. See Connection Bracket detail.
4. Mechanically lift the exposed Anchor Rail until it aligns with the slot in the Anchor Post (Post 0) when at rest.

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

WARNINGS

The ET-SS Impact Head Connection Bracket must rest against the front side of Post#1 (between Posts 0-1) as shown in the Connection Bracket Detail above.

STEP 10 Anchor Paddle Assembly



Step 10, Instruction 2 Assembly Tip:

Remove the front nut and washer and install the ET-SS Anchor Paddle 90-degrees (90°) to ET-SS Anchor Rail. Place front washer and nut back onto bolt loosely to allow ET-SS Anchor Paddle rotation. Remove the rear nut and washer and drop the bolt slightly to allow the ET-SS Anchor Paddle to rotate into the proper position, aligned with the four (4) plies of the ET-SS Anchor Rail. Reassemble the front and rear bolt, washer and nut in the orientation shown above. Proceed to Step 3 and tighten as specified.

PARTS		
I	10007542	1 EA
W	10002815	2 EA
Q	10009526	2 EA

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

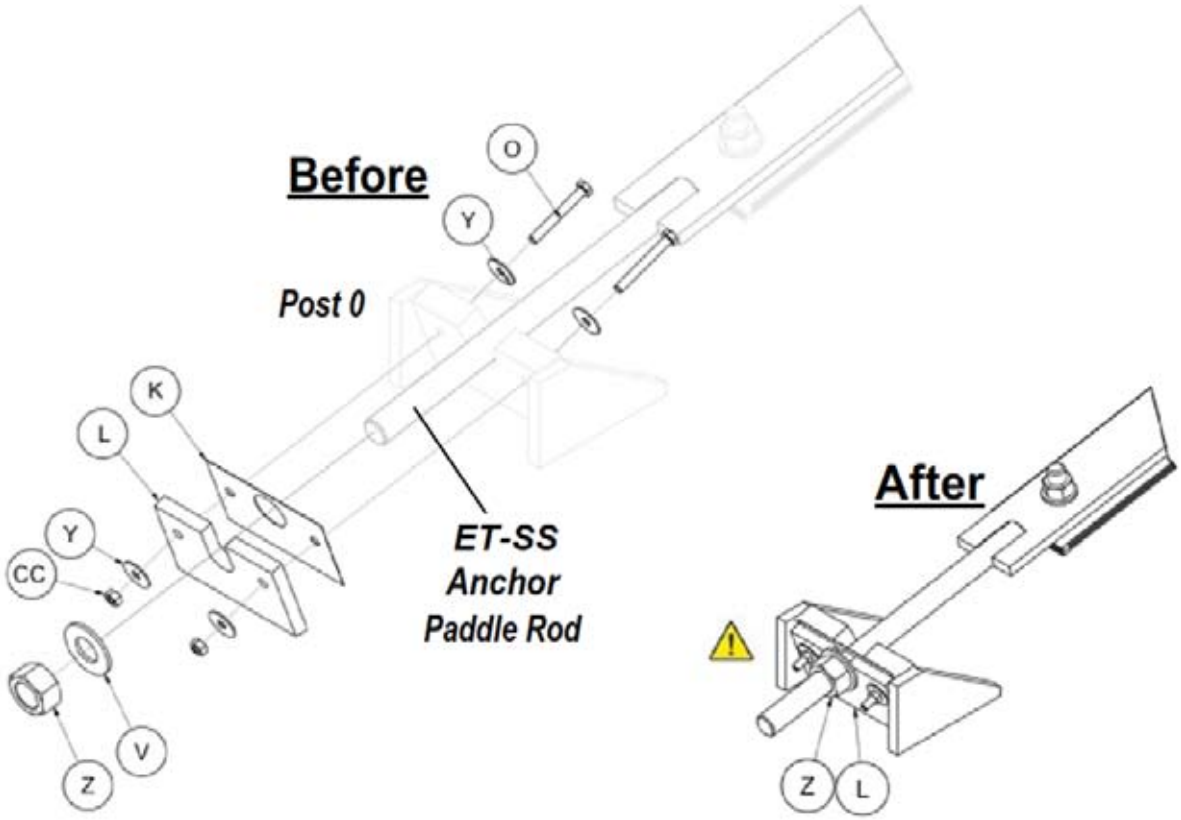
INSTRUCTIONS

1. Assemble all parts in the configuration & orientation shown above.
2. Remove the nuts (Part Q) and top washers (Part W) and place the Anchor Paddle (Part I) onto the hex bolts. The Anchor Paddle is assembled on the top side of the four (4) plies of the protruding Anchor Rail. Reassemble the top washers and nuts onto the hex bolt as shown above. The use of locking pliers or c-clamps will aid the assembly process.
3. Tighten all threaded hardware to a snug position with an appropriately sized wrench or socket and ensure a minimum of two bolt threads are protruding beyond the nut.

WARNINGS

The ET-SS Anchor Paddle (Part I) must be placed on the topside of the ET-SS Anchor Rail. Failure to follow this warning could result in serious injury or death in the event of a collision.

STEP 11 Anchor Post Assembly (Post 0)



PARTS		
Y	10009444	4 EA
CC	10009443	2 EA
Z	10007549	1 EA
V	10007548	1EA
L	10007546	1 EA
K	10007546	1 EA
O	10009442	2 EA

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

INSTRUCTIONS

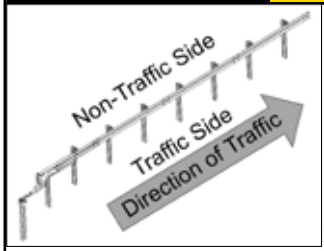
1. Assemble all parts in the configuration & orientation shown above.
2. Place the rod portion of the ET-SS Anchor Paddle in the notch of Post 0.
3. Place the ET-SS Keeper Plate (Part K) and ET-SS Plate Washer (Part L) onto the ET-SS Anchor Paddle Rod and fasten to Post 0 using shown hardware (Part O, Y, CC).
4. Place washer (Part V) then nut (Part Z) on the ET-SS Anchor Paddle Rod.
5. Tighten all threaded hardware to a snug position with an appropriately sized wrench or socket.

WARNINGS

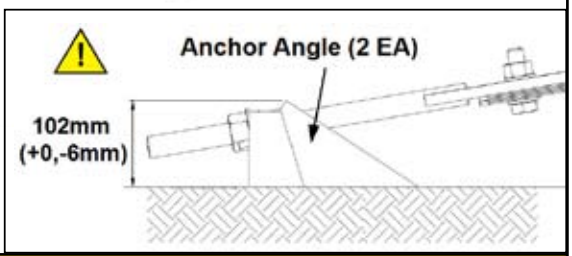
Ensure the 1" Hex Nut (Part Z) has been fully tightened against the ET-SS Plate Washer (Part L). Failure to follow this warning could result in serious injury or death in the event of a collision.

The paddle bolt shall extend beyond, or is at least flush, with the outer face of the 1" Nut (Part Z) when installed.

STEP 12 Angle Strut Assembly (Posts 0-1)



Note: Items below grade shown for clarity.



PARTS		
X	10009527	2 EA
R	10009528	1 EA
M	10007544	2 EA
N	10007547	1 EA
S	10009525	1 EA

INSTRUCTIONS

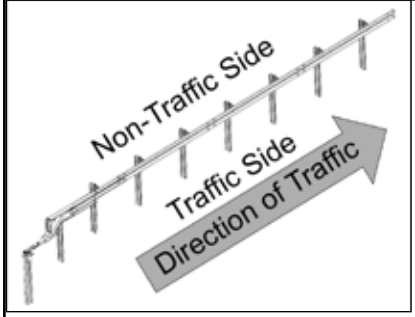
1. Assemble all parts in the configuration & orientation shown above.
2. It will be necessary to make a shallow valley/trough between Post 0 & 1 for the ET-SS Angle Strut (Part N) and ET-SS Anchor Angles (Part M), since a portion will be below the finished grade.
3. Position the ET-SS Anchor Angles (Part M) onto Post 0 and place ET-SS Angle Strut on the non-traffic side with short leg down and fasten to Post 0 & 1 using shown hardware (Part R, S, X). Components R and S (structural bolts) include structural nut and washer, and each requires an additional second washer.
4. Tighten all threaded hardware to a snug position with an appropriately sized wrench or socket.

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

WARNINGS

Ensure fully assembled ET-SS Anchor Post height (with ET-SS Anchor Angles) does not exceed 102mm above finished grade line.

STEP 13 Delineation Assembly



PARTS		

1. Assemble all parts in the configuration & orientation shown above.

Note: Manufacturer suggests that user provide delineation (reflective sheeting) of the terminal.

Use only Trinity Highway parts that are specified herein for the ET-SS System for assembling, maintaining, or repairing the ET-SS System. Do not utilise or otherwise comingle parts from other systems even if those systems are Trinity Highway systems.

WARNINGS

Ensure delineation (reflective sheeting) used on ET-SS System meets road authority specifications for proper delineation. Use of steel delineator posts are not permitted within 1m of the ET-SS System.

9.0 ET-SS Installation Checklist - Driven Posts

Customer:

Project:

Barrier ID: Terminal Type: ☐ MASH TL2 ☐ MASH TL3

Checked By: Signed: Date:

1. Is the assembled Anchor post installed in the correct orientation with the sloped side facing the terminal and within tolerance (102 +0/-6 mm measured from ground level to the top of the Anchor Angles)	☐ Yes	☐ No
2. Is Anchor Keeper Plate installed in correct configuration on Anchor post (Step 11)	☐ Yes	☐ No
3. Have Anchor post Angles been correctly bolted to the Anchor post (Step 12)	☐ Yes	☐ No
4. Is the Ground Strut bolted to the Anchor post and post 1 (Step 12)	☐ Yes	☐ No
5. The ET-SS head is bolted to post 1 (Step 9)	☐ Yes	☐ No
6. Are SYT posts positioned at locations 1 & 2, with yield holes approximately centred at finished grade line	☐ Yes	☐ No
7. Are posts 2 through 8 at the correct height of 813mm ±20mm above ground level	☐ Yes	☐ No
8. Are the rails secured to posts 3 through 8 (posts 3 through 5 for the TL2 configuration)	☐ Yes	☐ No
9. Ensure first rail is NOT secured to post at location 2	☐ Yes	☐ No
10. Have the rails been joined with M16x32mm splice head bolts	☐ Yes	☐ No
11. Are all splice bolts, post bolts and other fasteners snug tight	☐ Yes	☐ No
12. Do the standard W-Beam rails form a smooth line vertically and horizontally when viewed along the system, with no curved rails	☐ Yes	☐ No
13. Is all back-filled material around each post suitably compacted	☐ Yes	☐ No
14. Is the area below the guardrails free from hazards so that the ET-SS head can travel freely upon impact	☐ Yes	☐ No
15. Ensure any minor damage been repaired using two coats of an organic zinc rich paint	☐ Yes	☐ No
16. When installed on a flare, ensure flare rate is no greater than 1:25 (610mm offset from straight barrier over full length for TL3 configuration, 305mm for TL2 configuration)	☐ Yes	☐ No
17. Ensure ET-SS Terminal Rails are lapped correctly as per Section 7.1 (page 16) as Approach or Departure/Trailing as per location.	☐ Yes	☐ No

9.1 ET-SS Installation Checklist - TL2/TL3 Baseplated Posts

Customer:

Project:

Barrier ID:

Checked By: Signed: Date:

1. Has the terminal been installed on the standard foundation, as per SS-STD-011 (TL2) and SS-STD-014 (TL3), or alternative designed by a suitably qualified engineer	☐ Yes	☐ No
2. Is Anchor Keeper Plate installed in correct configuration on Anchor post (Step 11)	☐ Yes	☐ No
3. Have Anchor post Angles been correctly bolted to the Anchor post (Step 12)	☐ Yes	☐ No
4. Is the assembled Anchor bracket installed in the correct orientation with the sloped side facing the terminal	☐ Yes	☐ No
5. Are all anchor studs snug tight with no more than 10mm stud protruding above nut	☐ Yes	☐ No
6. The ET-SS head is bolted to post 1 (Step 9)	☐ Yes	☐ No
7. Are SYT posts positioned at locations 1 & 2	☐ Yes	☐ No
8. Are the rails secured to posts 3 through 5 for TL2 and 3 through 8 for TL3	☐ Yes	☐ No
9. Ensure first rail is NOT secured to post at location 2	☐ Yes	☐ No
10. Have the rails been joined with M16x32mm splice head bolts	☐ Yes	☐ No
11. Are all splice bolts, post bolts and other fasteners snug tight	☐ Yes	☐ No
12. Do the standard W-Beam rails form a smooth line vertically and horizontally when viewed along the system, with no curved rails	☐ Yes	☐ No
13. Is all back-filled material around the concrete foundation suitably compacted	☐ Yes	☐ No
14. Is the area below the guardrails free from hazards so that the ET-SS head can travel freely upon impact	☐ Yes	☐ No
15. Ensure any minor damage been repaired using two coats of an organic zinc rich paint	☐ Yes	☐ No
16. When installed on a flare, ensure flare rate is no greater than 1:25: 305mm offset from straight barrier over full length for TL2 configuration, and 610mm offset from straight barrier over full length for TL3 configuration	☐ Yes	☐ No
17. Ensure ET-SS Terminal Rails are lapped correctly as per Section 7.1 (page 16) as Approach or Departure/Trailing as per location.	☐ Yes	☐ No

Disclaimer:
Important Note: The conformity of the installation is the responsibility of the installation contractor, and Ingal Civil Products accepts no liability for or in connection with any installation that is outside of the specifications of this manual or the Road Controlling Authority. For more information, please refer to our Standard Terms and Conditions of Sale available on our website: www.ingalcivil.com.au.

10.0 Maintenance and Repair

Except for repairs due to impacts, there is virtually no maintenance required for the system. It is recommended that annual inspections be performed to ensure the following;

- The terminal is appropriately delineated.
- Debris has not accumulated around the terminal that may impede the travel of the extruder head.
- The blocking pieces have not rotated (post bolts tight).
- Nut on Anchor Paddle is snug tight.

10.1 Bush Fire Damage

All steel items used for the assembly of the ET-SS are hot dip galvanized. The performance of galvanized coatings when subjected to fires depends upon a number of factors, such as flame duration, intensity and the characteristics of the galvanized coating.

Typical bushfire conditions may expose steel structures to an 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 temperature 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 also typically remain unaffected through a bushfire event. If the bushfire causes damage to the galvanized surface, then the item(s) shall be replaced. It is recommended that the blocking pieces be replaced at these locations.

If an item to be replaced is a post or rail, it is recommended that the blocking pieces be replaced at these locations.

10.2 Damage Assessment

In the event of a vehicle impact, damage to the terminal is to be assessed in accordance with Table 2. A Safe Work Method Statement is available upon request to assist in the safe repair of the ET-SS. Only items purchased from Ingal shall be used for the repair of the ET-SS.

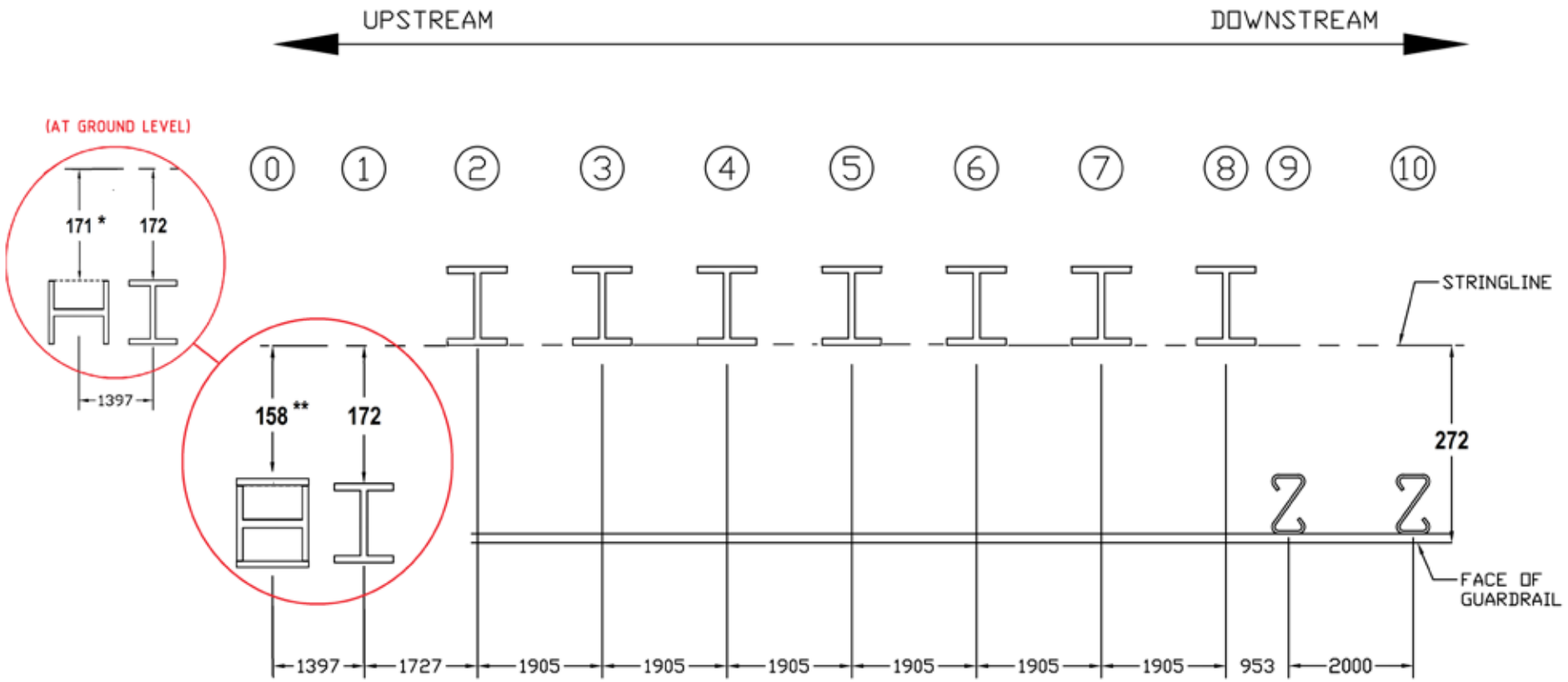
When replacing posts, ensure that the disturbed foundation material is suitably compacted prior to the installation of replacement posts.

Damage Assessment of ET-SS

Type of Defect	Description of the Defect	Action to be Taken
Galvanizing damage on Posts.	The sum total of the damaged area does not exceed 45cm^2 (0.5% of the total surface area) and no individual damaged area exceeds 40cm^2 . The sum total of the damaged area exceeds 45cm^2 (0.5% of the total surface area) or an individual damaged area exceeds 40cm^2 .	A zinc metal spray in accordance with ISO2063 or AS/NZS 2312 is to be applied to the repair area. The post is to be replaced
Galvanizing damage on rails.	The sum total of the damaged area does not exceed 200cm^2 (0.5% of the total surface area) and no individual damaged area does not exceed 40cm^2. The sum total of the damaged area exceeds 200cm^2 (0.5% of the total surface area) and/or an individual damaged area exceeds 40cm^2.	A zinc metal spray in accordance with ISO2063 or AS/NZS 2312 is to be applied to the repair area. The rail is to be replaced.
Mechanical damage on blocking pieces	The blocking piece has chips or cracks.	The blocking piece is to be replaced.
Mechanical damage on SYT or line posts.	The post is bent.	The post is to be replaced.
Mechanical damage on impact head	The impact head has minor damage that will not prevent its travel along the rail. The impact head is bent which will prevent its travel along the rail. The delineation tape is damaged.	The impact head may be reused. The impact head is to be replaced. The delineation tape is to be replaced.
Mechanical damage on rail.	The rail is dented, twisted or flattened. There are nicks in any part of the rail. The slots in the rail are distorted.	The rail is to be replaced. The rail is to be replaced. The rail is to be replaced.
Mechanical damage on bolts.	The body of the bolt is distorted. The thread of the bolt is damaged.	The bolt is to be replaced. The bolt is to be replaced.
Disturbance of material around posts.	The material around the post is loose or uncompacted.	Any disturbed pavement or material around a post shall be left dense, tight and smooth so that resistance to water penetration is similar to that of the adjacent surface.

Note: If the ET-SS terminal has been involved in an end-on impact, the impact head shall be replaced.

ET-SS System Test Level 3 (Posts 0-8) – Post Placement Diagram



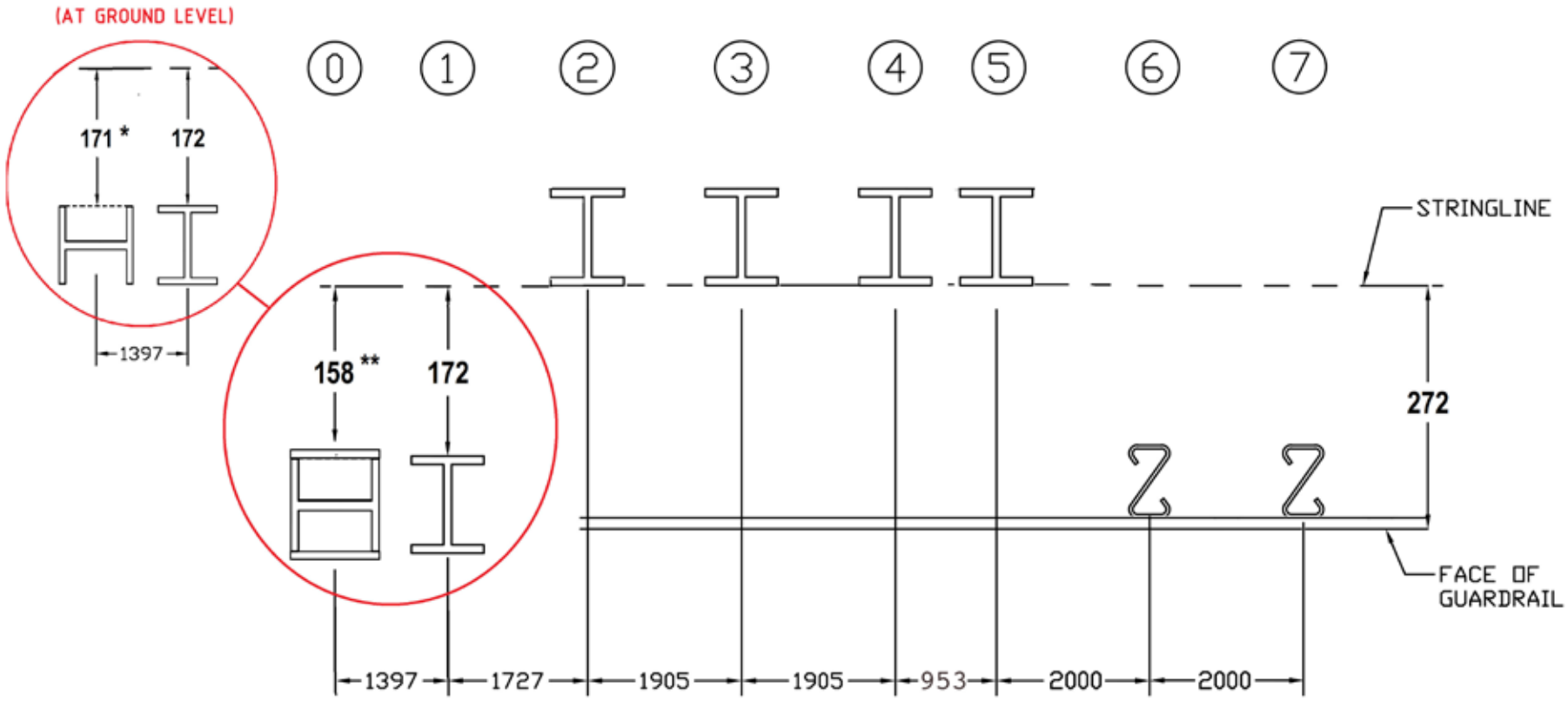
* Measured from the edge of Anchor Post's I-section
** Measured from the Anchor Post's plates

TRAFFIC DIRECTION

NOTES:

1. Post 0-8 part of ET-SS System TL3
2. Post 9 is first post of longitudinal w-beam system (not included with ET-SS System)
3. Spacing between posts is on centre as shown
4. All ET-SS System posts must be installed plumb
5. Guardrail splice joint located at Post 9

ET-SS System Test Level 2 (Posts 0-5) – Post Placement Diagram



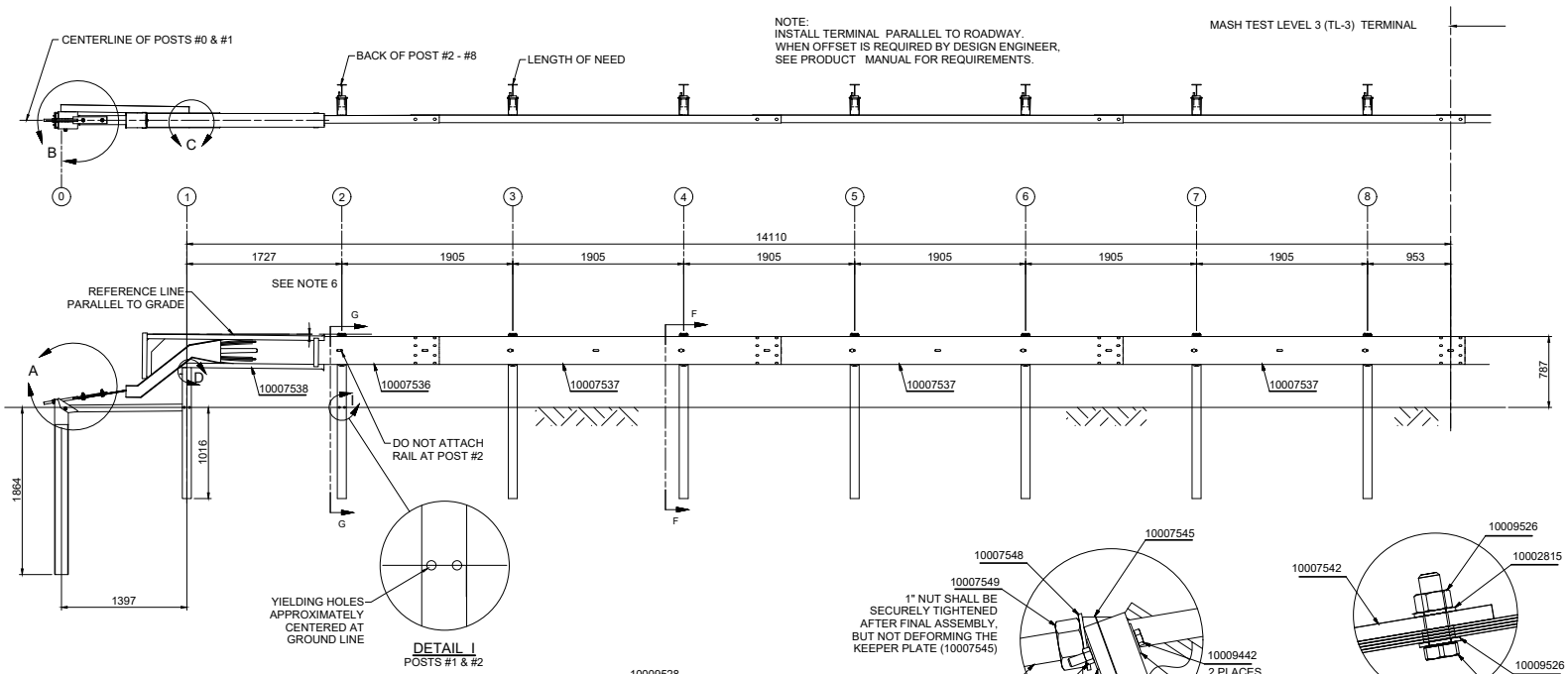
* Measured from the edge of Anchor Post's I-section
** Measured from the Anchor Post's plates

TRAFFIC DIRECTION

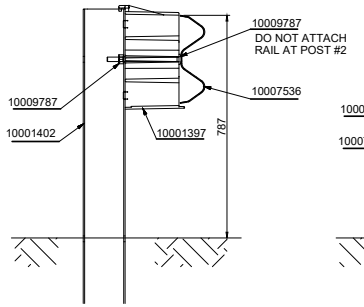
NOTES:

1. Post 0-5 part of ET-SS System TL2
2. Post 6 is first post of longitudinal w-beam system (not included with ET-SS System)
3. Spacing between posts is on centre as shown
4. All ET-SS System posts must be installed plumb
5. Guardrail splice joint located at Post 5

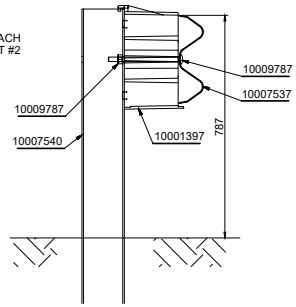
PARTS LIST		
PART NO.	QTY.	DESCRIPTION
10007537	3	TERMINAL GUARDRAIL
10007540	6	LINE POST 1830mm
10001397	7	KING BLOCK
10001402	1	SYT POST #2 1830mm
10007536	1	ANCHOR G.RAIL
10007544	2	ANCHOR ANGLE
10007547	1	ANGLE STRUT
10007539	1	POST#1 SYTP
10007542	1	ANCHOR PADDLE
10007543	1	POST#0
10007546	1	PLATE WASHER
10007545	1	KEEPER PLATE
10007538	1	IMPACT HEAD
		~ HARDWARE ~
10009441	1	M8 x 40mm Grade 8.8 Hex Bolt Galv
10009442	2	M8 x 65mm Grade 8.8 Hex Bolt Galv
10009443	3	M8 Hex Nuy Galv 8.8
10009444	6	M8 Round Washer Galv - OD 28.6mm
10009525	1	M16 x 45mm Structural Hex B/N/W
10009528	1	M16 x 240mm Structural Hex B/N/W
10009527	2	M16 Structural Washer Galv
10009787	7	M16 x 250mm Post Bolt & Oversize Nut
10009526	2	M20 x 65mm Structural Hex B/N/W
10002815	2	M20 Structural Washer Galv
10001239	32	M16 Oversize Nut
10001248	32	M16 x 32mm Splice Bolt Grade 8.8
10007548	1	1" ROUND WASHER F436
10007549	1	1" HVY HEX NUT A563 DH



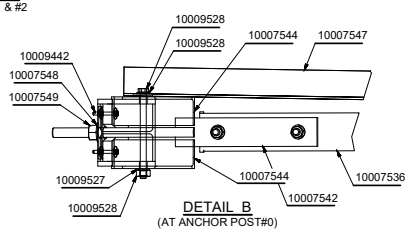
DETAIL I
POSTS #1 & #2



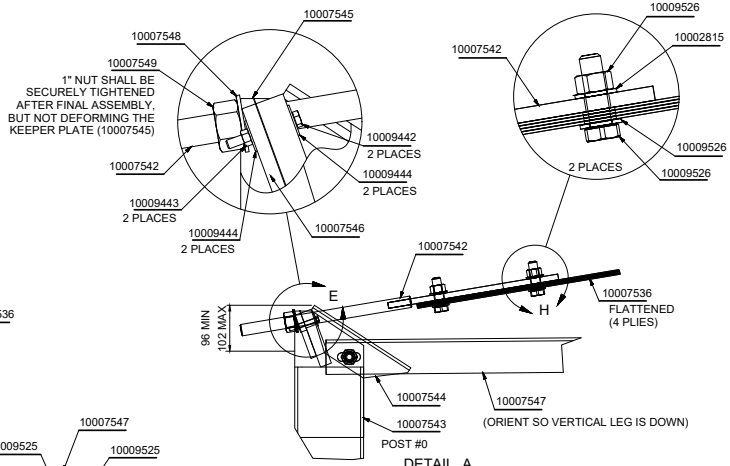
SECTION G-G
(POST #2)



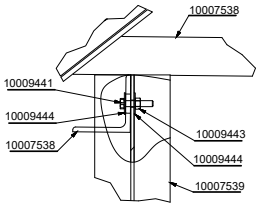
SECTION F-F
(POST #3 - #8)



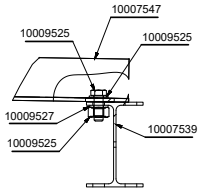
DETAIL B
(AT ANCHOR POST#0)



DETAIL A



DETAIL D
(POST #1)



DETAIL C
(POST #1, SHOWN NEAR GROUND)

NOTES:
1. REFER TO PRODUCT ASSEMBLY MANUAL.
2. PROPER SITE GRADING SHOULD BE ACCOMPLISHED IN ACCORDANCE WITH LOCAL SPECIFYING AGENCY GUIDELINES AND THE AASHTO ROADSIDE DESIGN GUIDE.
3. DO NOT ATTACH THE TERMINAL DIRECTLY TO A RIGID BARRIER.
4. UNDER NO CIRCUMSTANCES SHALL THE GUARDRAIL WITHIN THE TERMINAL BE CURVED.
5. MANUFACTURER SUGGESTS CUSTOMER TO PROVIDE REFLECTORIZATION OF THE TERMINAL.
6. IT IS ACCEPTABLE TO INSTALL THE TERMINAL IMPACT HEAD PARALLEL TO THE GRADE LINE OR WITH AN UPWARD TILT. SEE PRODUCT ASSEMBLY MANUAL FOR SPECIFIC DETAILS.

REVISIONS

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
8	13-07-2022	UPDATED PART NO.	KZ	LG	LG
7	29-03-2021	DIM ADDITIONS	VB	LG	LG
6	18-03-2020	PARTS LIST UPDATED (IMPERIAL TO METRIC)	VB	LG	LG
5	27-08-2019	PRODUCT NAME UPDATED	VB	LG	LG
4	04-06-2019	HEIGHT OF ANCHOR ANGLES UPDATED	VB	LG	LG
3	04-02-2019	MIRRORED DRAWING TO MATCH LEADING TERMINAL	VB	LG	LG
2	25-07-2016	DRAWING LAYOUT UPDATED	MC	SE	LG
1	01-10-2015	BOM UPDATED	LG	SE	LG

REFERENCES

DRAWING NUMBER	REFERENCE DRAWINGS

	NAME	DATE
DRAWN	TRIN	14-11-2012
CHECKED	LG	28-05-2015
APPROVED	LG	28-05-2015
SCALE	N.T.S. @ A3	
ISSUE FOR	INFORMATION ONLY	

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PROJECT

TITLE
MASH GUARDRAIL END TERMINAL
ET-SS
GENERAL ARRANGEMENT

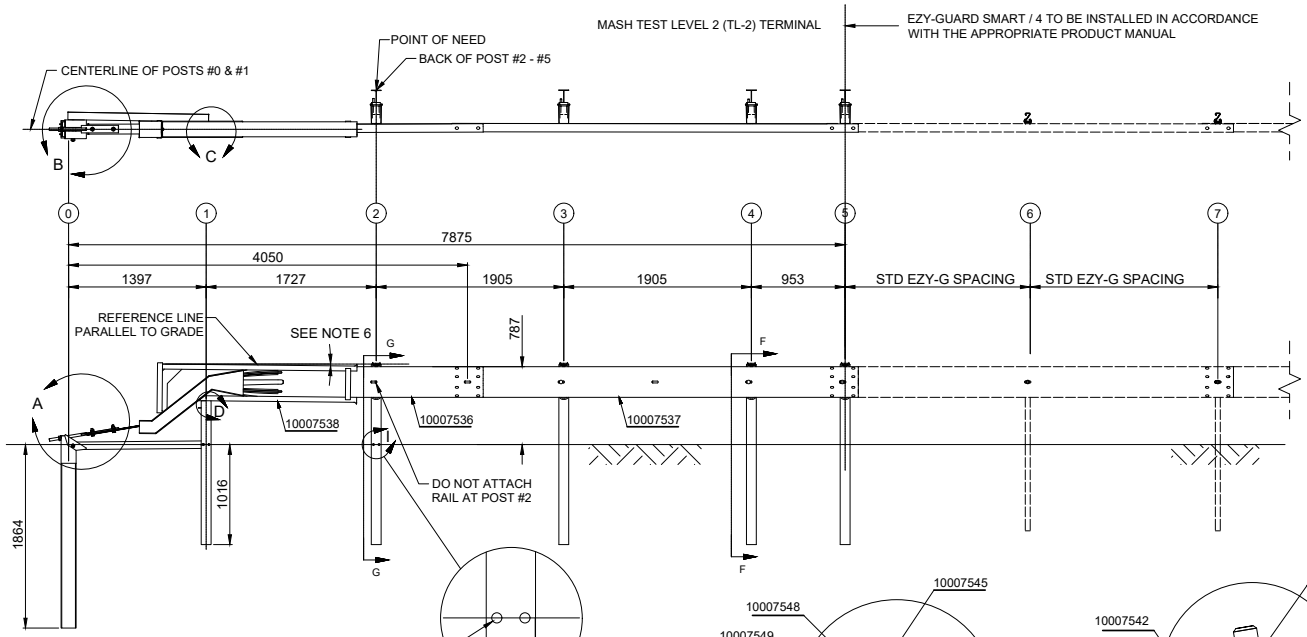
INGAL CIVIL PRODUCTS PART No.
10007556

DRAWING No.
SS-STD-001

Rev: 8

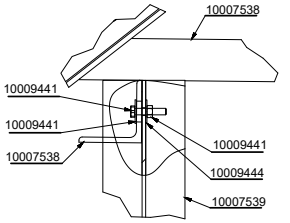
F:\ENGINEERING\SALES & MARKETING\DRAWING SET S\SS\SS-STD-001 - ET-SS GA.DWG

PARTS LIST		
PART NO.	QTY.	DESCRIPTION
10007537	1	3.81m NLL Guardrail
10007540	3	Line Post 1830mm
10001397	4	KING BLOCK
10001402	1	SYT Post #2 1830mm
10007536	1	TERMINAL ANCHOR G.RAIL
10007544	2	ANCHOR ANGLE
10007547	1	ANGLE STRUT
10007539	1	POST#1 SYTP
10007542	1	ANCHOR PADDLE
10007543	1	ANCHOR POST#0
10007546	1	PLATE WASHER
10007545	1	KEEPER PLATE
10007538	1	IMPACT HEAD
		~ HARDWARE ~
10009442	2	M8 x 65mm Hex Bolt
10009441	1	M8 x 40mm Hex Bolt
10009526	2	M20 x 65mm Structural Hex B/N/W
10009528	1	M16 x 240mm Structural Hex B/N/W
10009525	1	M16 x 45mm Structural Hex B/N/W
10009787	4	M16 x 250 Post Bolt & Oversize Nut
10001248	16	M16 x 32mm Splice Bolts
10007548	1	1" Round Washer
10002815	2	M20 Structural Washer Galv
10009527	2	M16 Structural Washer Galv
10009444	6	M8 Round Washer Wide
10007549	1	1" Heavy Hex Nut
10001239	16	M16 Oversize Splice Nut
10009443	3	M8 Hex Nut



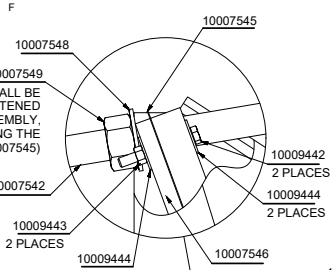
NOTES:

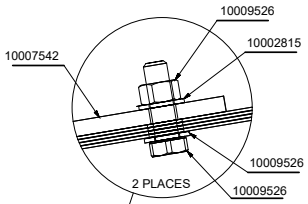
1. TO BE READ IN CONJUNCTION WITH THE PRODUCT MANUAL.
2. PROPER SITE GRADING SHOULD BE IN ACCORDANCE WITH ROAD CONTROLLING AUTHORITY GUIDELINES AND THE AASHTO ROADSIDE DESIGN GUIDE.
3. DO NOT ATTACH THE TERMINAL DIRECTLY TO A RIGID BARRIER.
4. UNDER NO CIRCUMSTANCES SHALL THE GUARDRAIL WITHIN THE TERMINAL BE CURVED.
5. DELINEATION TO BE IN ACCORDANCE WITH THE ROAD CONTROLLING AUTHORITY GUIDELINES.
6. IT IS ACCEPTABLE TO INSTALL THE TERMINAL IMPACT HEAD PARALLEL TO THE GRADE LINE OR WITH AN UPWARD TILT. SEE PRODUCT MANUAL FOR SPECIFIC DETAILS.
7. INSTALL TERMINAL PARALLEL TO ROADWAY. WHEN OFFSET IS REQUIRED BY DESIGN ENGINEER, SEE PRODUCT MANUAL FOR REQUIREMENTS.

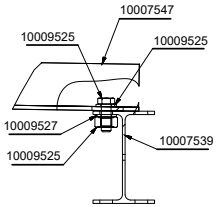


DETAIL D
(POST #1)

DETAIL I
POSTS #1 & #2







DETAIL C
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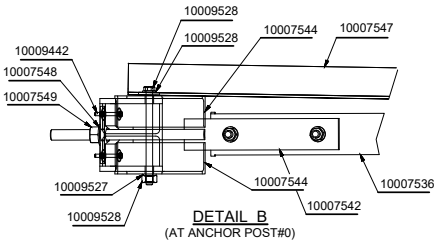

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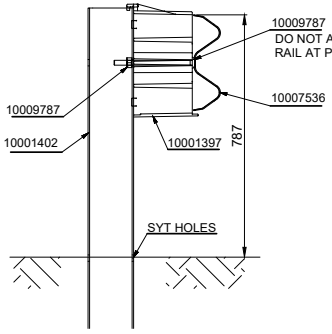
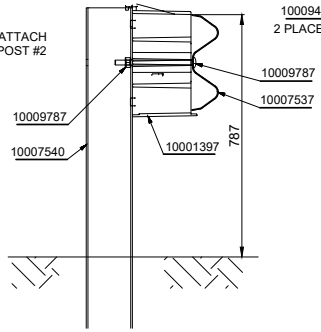
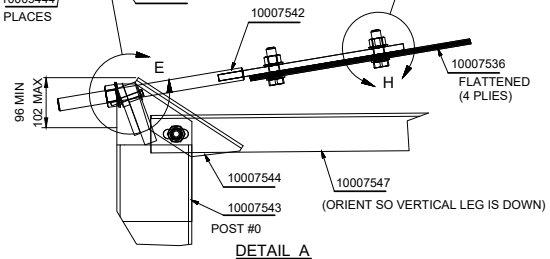


SECTION G-G
(POST #2)



SECTION F-F
(POST #3 - #5)



DETAIL A

REVISIONS						
REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
3	13-07-2022	UPDATED PART NO.	KZ	LG	LG
2	08-01-2021	POINT OF NEED UPDATED	VB	LG	LG
1	08-09-2020	NOTES AMMENDED	VB	LG	LG

REFERENCES	
DRAWING NUMBER	REFERENCE DRAWINGS

	NAME	DATE
DRAWN	LG	17-02-2020
CHECKED	VB	07-05-2020
APPROVED	LG	07-05-2020
SCALE	N.T.S. @ A3	
ISSUE FOR	INFORMATION ONLY	

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PROJECT: MASH GUARDRAIL END TERMINAL

INGAL CIVIL PRODUCTS PART No.: 10009260

TITLE: MASH GUARDRAIL END TERMINAL
ET-SS
TL2 GENERAL ARRANGEMENT

DRAWING No.: SS-STD-012

Rev: 3

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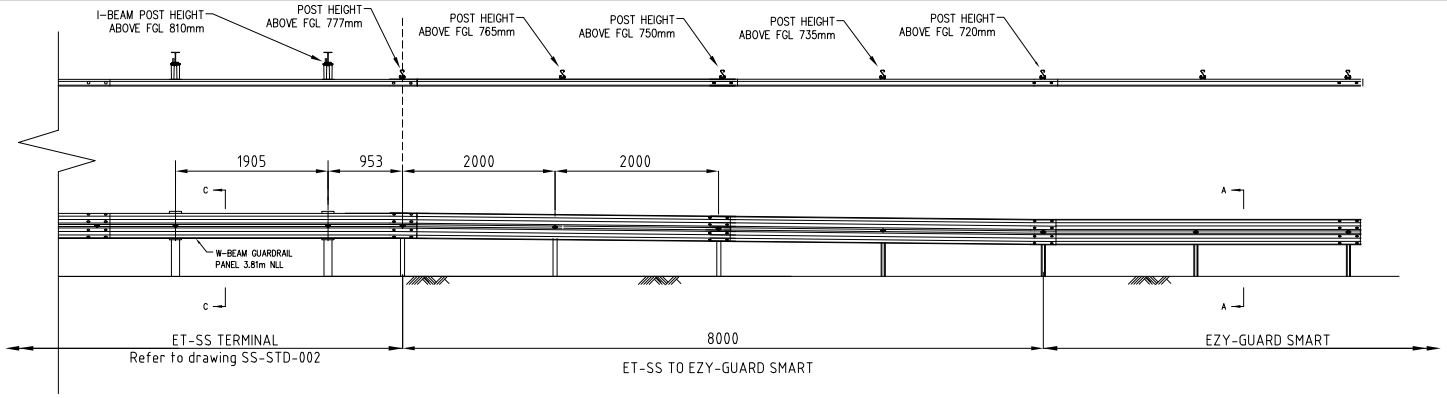
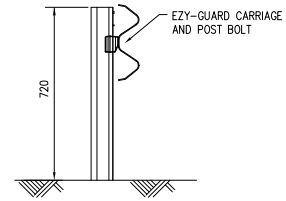
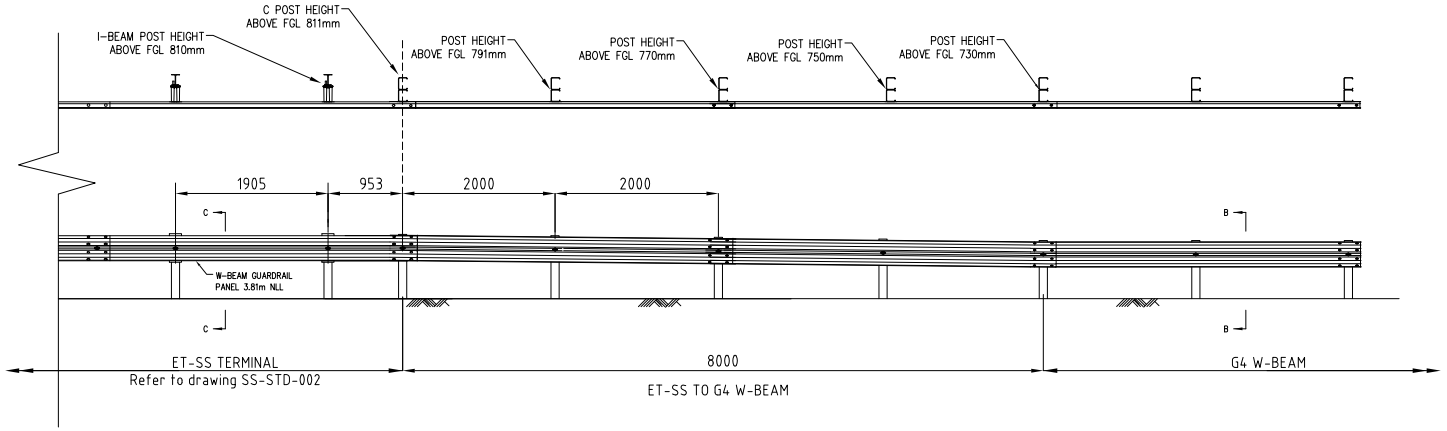
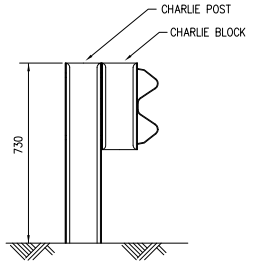


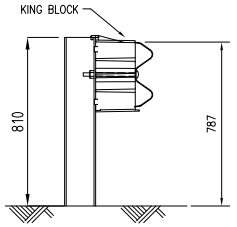


SECTION "A-A

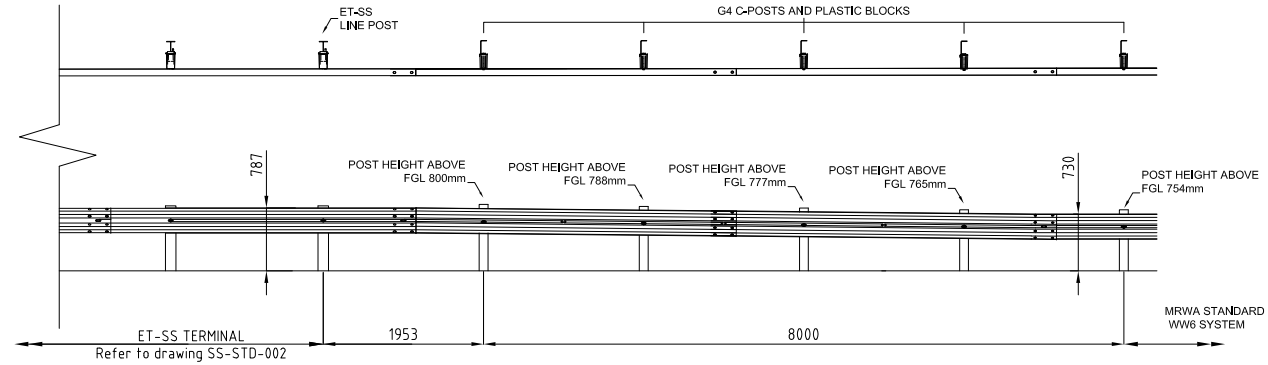




SECTION "B-B



SECTION "C-C



NOTES:
1) TO BE READ IN CONJUNCTION WITH THE ET-SS PRODUCT MANUAL.
2) THE ET-SS IS A MASH TL-3 AND TL-2 END TREATMENT.
3) ALL STEEL COMPONENTS HDG TO AS/NZS4680.
4) DELINEATION OF TERMINAL TO BE IN ACCORDANCE WITH LOCAL AUTHORITY REQUIREMENTS

REVISIONS

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
2	08-09-2020	WW6 DETAIL ADDED	VB	LG	LG
1	27-06-2019	PRODUCT NAME UPDATED	VB	LG	LG

REFERENCES

DRAWING NUMBER	REFERENCE DRAWINGS

	NAME	DATE
DRAWN	VB	21-01-2019
CHECKED	LG	21-01-2019
APPROVED	LG	21-01-2019
SCALE	VARIES @ A3	
ISSUE FOR	INFORMATION ONLY	

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PROJECT: GUARDRAIL END TERMINALS

INGAL CIVIL PRODUCTS PART No.:

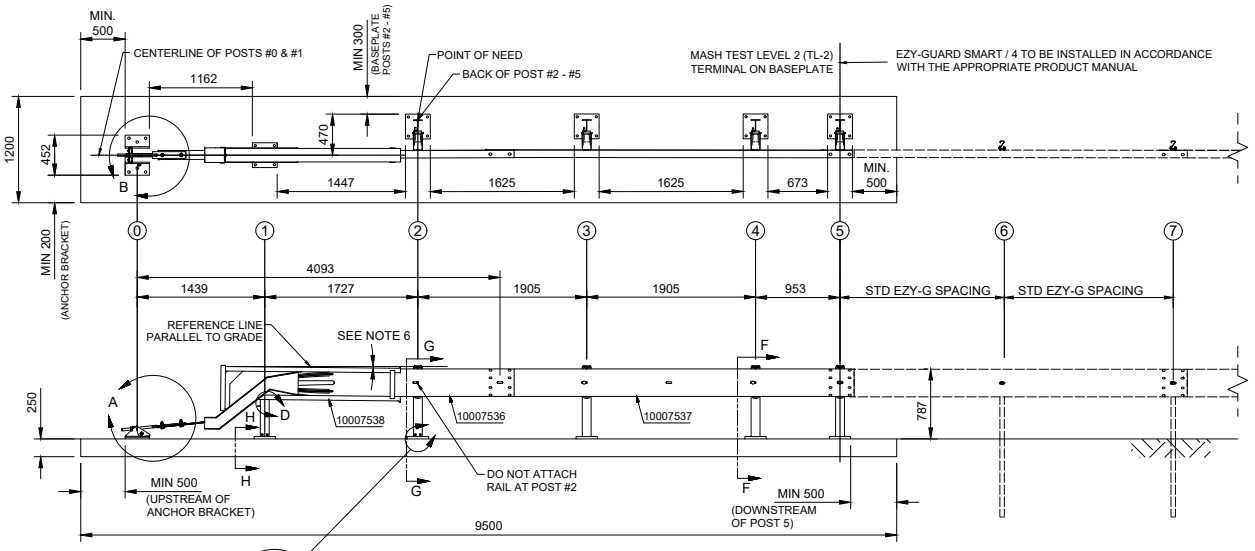
TITLE: MASH ET-SS
TRANSITION TO W-BEAM GUARDRAIL
GENERAL ARRANGEMENT

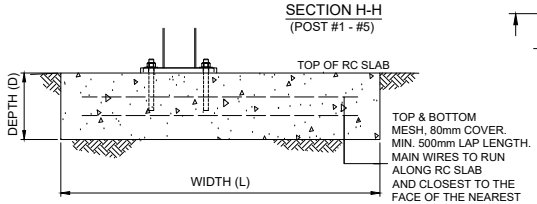
DRAWING No.: SS-STD-005

Rev: 2

J:\SALES & MARKETING\DRAWINGS\ET-SS\SS-STD-005 - ET-SS TRANSITION TO EZY-GUARD SMART AND G4.DWG

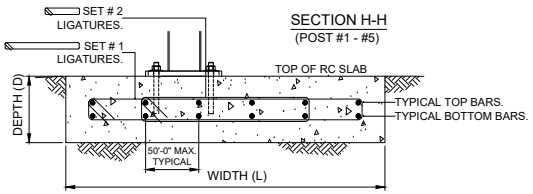
PARTS LIST		
PART NO.	QTY.	DESCRIPTION
10007537	1	Terminal Guardrail 3.81m NLL
10009493	3	BP Line Post 813mm
10001397	4	KING BLOCK
10009491	1	BP SYT Post #2 813mm
10007536	1	ANCHOR GUARDRAIL
10009776	2	BP ANCHOR ANGLE
10009495	1	BP SYT Post #1 440mm
10007542	1	ANCHOR PADDLE
10009777	1	ANCHOR BRACKET
10009778	1	BP PLATE WASHER
10007545	1	KEEPER PLATE
10007538	1	IMPACT HEAD
		~ HARDWARE ~
10009441	1	M8 x 40mm Grade 8.8 Hex Bolt Galv
10009442	2	M8 x 65mm Grade 8.8 Hex Bolt Galv
10009443	3	M8 Hex Nuy Galv 8.8
10009444	6	M8 Round Washer Galv - OD 28.6mm
10009787	4	M16 x 250mm Post Bolt & Oversize Nut
10009526	2	M20 x 65mm Structural Hex B/N/W
10002815	2	M20 Structural Washer Galv
10001239	16	M16 Oversize Nut
10001248	16	M16 x 32mm Splice Bolt Grade 8.8
10007548	1	1" ROUND WASHER F436
10007549	1	1" HVY HEX NUT A563 DH





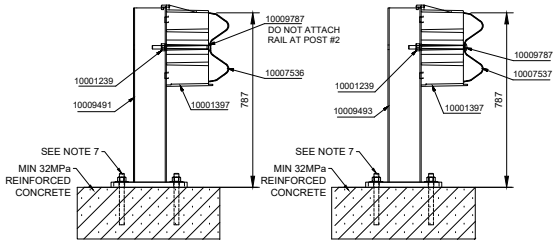
TYPICAL 9.5M LONG RC SLAB SECTION–REINFORCING MESH OPTION

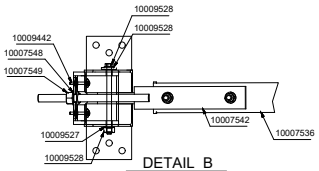
RC SLAB SECTION–REINFORCING MESH OPTION (MINIMUM REINFORCEMENT)			
D MIN. DEPTH (mm)	L MAX. WIDTH (mm)	REINFORCEMENT TOP	REINFORCEMENT BOTTOM
250	1200	RL918 MESH [MIN. (11) LONGITUDINAL WIRES PER LAYER]	RL918 MESH [MIN. (11) LONGITUDINAL WIRES PER LAYER]

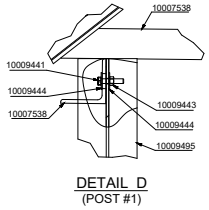


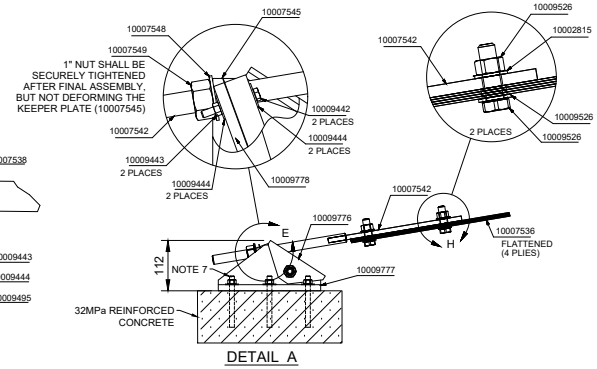
TYPICAL 9.5M LONG RC SLAB SECTION–REINFORCING BAR OPTION

RC SLAB SECTION–REINFORCING BAR OPTION (MINIMUM REINFORCEMENT)					
D MIN.DEPTH (mm)	L MAX.WIDTH (mm)	REINFORCEMENT (TOP BARS)	(BOTTOM BARS)	LIGATURES, 80 COVER SET # 1	SET # 2
250	1200	6–N16	6–N16	R10–300 CTS	R10–300 CTS









NOTES:
1. TO BE READ ON CONJUNCTION WITH PRODUCT MANUAL.
2. PROPER SITE GRADING SHOULD BE ACCOMPLISHED IN ACCORDANCE WITH LOCAL SPECIFYING AGENCY GUIDELINES AND THE AASHTO ROADSIDE DESIGN GUIDE.
3. DO NOT ATTACH TERMINAL DIRECTLY TO A RIGID BARRIER.
4. UNDER NO CIRCUMSTANCES SHALL THE GUARDRAIL WITHIN THE TERMINAL BE CURVED.
5. IT IS ACCEPTABLE TO INSTALL THE IMPACT HEAD PARALLEL TO THE GRADE LINE OR WITH AN UPWARD TILT. SEE PRODUCT MANUAL FOR SPECIFIC DETAILS.
6. INSTALL TERMINAL PARALLEL TO ROADWAY. WHEN OFFSET IS REQUIRED BY DESIGN ENGINEER, SEE PRODUCT MANUAL FOR REQUIREMENTS.
7. FOUR M20 G8.8 ANCHOR STUDS PER POST AND SIX IN RAIL ANCHOR. NOMINAL STUD LENGTH: 255mm. CHEMICALLY ANCHORED WITH RAMSET CHEMSET REO 502 PLUS OR HILTI HY-200. MIN EMBEDMENT 200mm. DO NOT DRILL DEEPER THAN 210mm FOR A 250mm SUBSTRATE THICKNESS. NO MORE THAN 20mm EXTENDING ABOVE NUT UPON COMPLETION.
8. ASSUMED SOIL CONDITIONS: Ø = 30° ; γ = 19 kN/m³ ; Cu = 50 kPa
9. WHERE GROUND CONDITIONS VARY FROM THE AFOREMENTIONED, A SITE SPECIFIC FOOTING MAY NEED TO BE DESIGNED.

REVISIONS

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
12	08/08/2023	HY-200 CHEMICAL ADDED	LG	KZ	LG
11	21-07-2022	UPDATED NOTE	KZ	LG	LG
10	13-07-2022	UPDATED PART NO.	KZ	LG	LG
9	24-06-2022	ANCHOR BRACKET MIN OFFSET TO 200mm.	KZ	LG	LG
8	02-03-2022	SECTION HH POST ADJUSTMENT	KZ	LG	LG
7	02-03-2022	MINOR BOM DESCRIPTION CHANGES	LG	KZ	LG
6	06-10-2021	NOTE 7 UPDATED	VB	LG	LG
5	16-08-2021	NOTES UPDATED	VB	LG	LG

REFERENCES

DRAWING NUMBER	REFERENCE DRAWINGS

	NAME	DATE
DRAWN	VB	13/03/2020
CHECKED	LG	13/03/2020
APPROVED	LG	13/03/2020
SCALE	N.T.S. @ A3	
ISSUE FOR	INFORMATION ONLY	

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PROJECT: ET-SS MASH TERMINAL

INGAL CIVIL PRODUCTS PART No.: 10009779

TITLE: ET-SS TL2 ON BASEPLATE GENERAL ARRANGEMENT

DRAWING No.: SS-STD-011

Rev: 12

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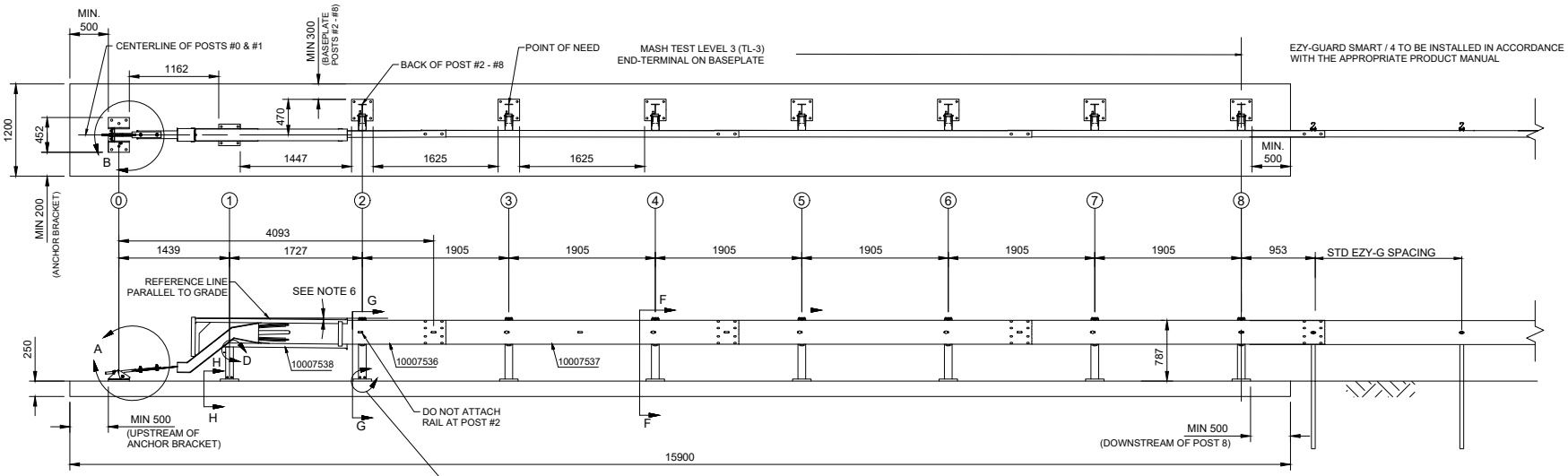
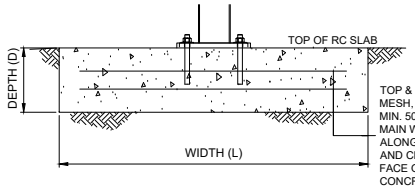
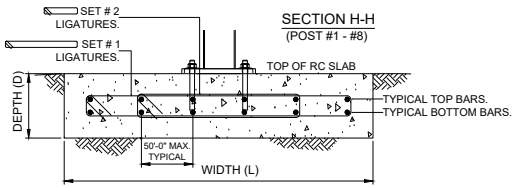
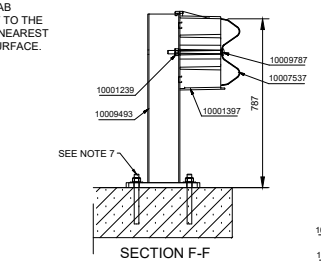


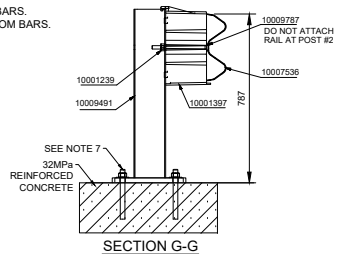


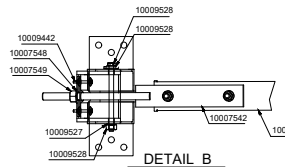
RC SLAB SECTION–REINFORCING MESH OPTION (MINIMUM REINFORCEMENT)			
D MIN. DEPTH (mm)	L MAX. WIDTH (mm)	REINFORCEMENT TOP	REINFORCEMENT BOTTOM
250	1200	RL918 MESH [MIN. (11) LONGITUDINAL WIRES PER LAYER]	RL918 MESH [MIN. (11) LONGITUDINAL WIRES PER LAYER]

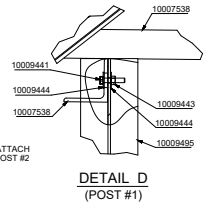


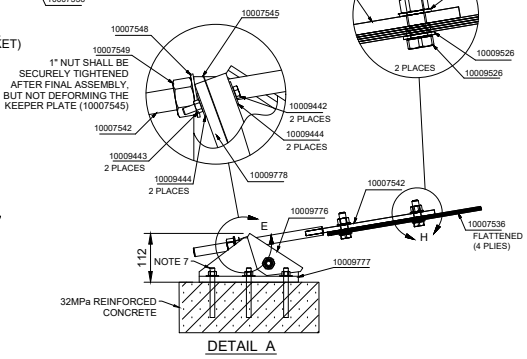
RC SLAB SECTION–REINFORCING BAR OPTION (MINIMUM REINFORCEMENT)					
D MIN.DEPTH (mm)	L MAX.WIDTH (mm)	REINFORCEMENT (TOP BARS)	(BOTTOM BARS)	LIGATURES, 80 COVER SET # 1	SET # 2
250	1200	6–N16	6–N16	R10–300 CTS	R10–300 CTS











PARTS LIST		
PART NO.	QTY.	DESCRIPTION
10007537	3	ET-SS Terminal Guardrail
10009493	6	ET-SS BP Line Post 813mm
10001397	7	KING BLOCK
10009491	1	ET-SS BP SYT Post #2 813mm
10007536	1	ET-SS ANCHOR G.RAIL
10009776	2	ET-SS BP ANCHOR ANGLE
10009495	1	ET-SS BP SYT Post #1 440mm
10007542	1	ET-SS ANCHOR PADDLE
10009777	1	ET-SS ANCHOR BRACKET
10009778	1	ET-SS BP PLATE WASHER
10007545	1	ET-SS KEEPER PLATE
10007538	1	ET-SS IMPACT HEAD
		~ HARDWARE ~
10009441	1	M8 x 40mm Grade 8.8 Hex Bolt Galv
10009442	2	M8 x 65mm Grade 8.8 Hex Bolt Galv
10009443	3	M8 Hex Nuy Galv 8.8
10009444	6	M8 Round Washer Galv - OD 28.6mm
10009787	7	M16 x 250mm Post Bolt & Oversize Nut
10009526	2	M20 x 65mm Structural Hex B/N/W
10002815	2	M20 Structural Washer Galv
10001239	32	M16 Oversize Nut
10001248	24	M16 x 32mm Splice Bolt Grade 8.8
10007548	1	1" ROUND WASHER F436
10007549	1	1" HVY HEX NUT A563 DH

NOTES:
1. REFER TO TERMINAL ASSEMBLY MANUAL.
2. PROPER SITE GRADING SHOULD BE ACCOMPLISHED IN ACCORDANCE WITH LOCAL SPECIFYING AGENCY GUIDELINES AND THE AASHTO ROADSIDE DESIGN GUIDE.
3. THE TERMINAL SHOULD NOT BE DIRECTLY ATTACHED TO A TO A RIGID BARRIER, A STIFFNESS TRANSITION MAY BE REQUIRED.
4. UNDER NO CIRCUMSTANCES SHALL THE GUARDRAIL WITHIN THE TERMINAL BE CURVED.
5. IT IS ACCEPTABLE TO INSTALL THE IMPACT HEAD PARALLEL TO THE GRADE LINE OR WITH AN UPWARD TILT. SEE ASSEMBLY MANUAL FOR SPECIFIC DETAILS.
6. INSTALL TERMINAL PARALLEL TO ROADWAY. WHEN OFFSET IS REQUIRED BY DESIGN ENGINEER, SEE ASSEMBLY MANUAL FOR FLARING REQUIREMENTS.
7. FOUR M20 G8.8 ANCHOR STUDS PER POST AND SIX IN RAIL ANCHOR. NOMINAL STUD LENGTH: 255mm. CHEMICALLY ANCHORED WITH RAMSET CHEMSET REO 502 PLUS OR HILTI HY-200. MIN EMBEDMENT 200mm. DO NOT DRILL DEEPER THAN 210mm FOR A 250mm SUBSTRATE THICKNESS. NO MORE THAN 20mm EXTENDING ABOVE NUT UPON COMPLETION.
8. ASSUMED SOIL CONDITIONS: Ø = 30° ; γ = 19 kN/m³ ; Cu = 50 kPa
9. WHERE GROUND CONDITIONS VARY FROM THE AFOREMENTIONED, A SITE SPECIFIC FOOTING MAY NEED TO BE DESIGNED.

REVISIONS

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
-					
-					
4	08/08/2023	HY-200 CHEMICAL ADDED	LG	KZ	LG
3	06-07-2023	NOTES UPDATE FROM ET-SS	KZ	LG	LG
2	15-02-2023	UPDATED MIN DISTANCE FOR ANCHOR POST	KZ	LG	LG
1	13-07-2022	UPDATED PART NO.	KZ	LG	LG

REFERENCES

DRAWING NUMBER	REFERENCE DRAWINGS

	NAME	DATE
DRAWN	VB	07-10-2021
CHECKED	LG	02-11-2021
APPROVED	LG	02-11-2021
SCALE	N.T.S. @ A3	
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PROJECT: ET-SS MASH TERMINAL

TITLE: ET-SS TL3 ON BASEPLATE GENERAL ARRANGEMENT

INGAL CIVIL PRODUCTS PART No.: -

DRAWING No.: SS-STD-014

Rev: 4

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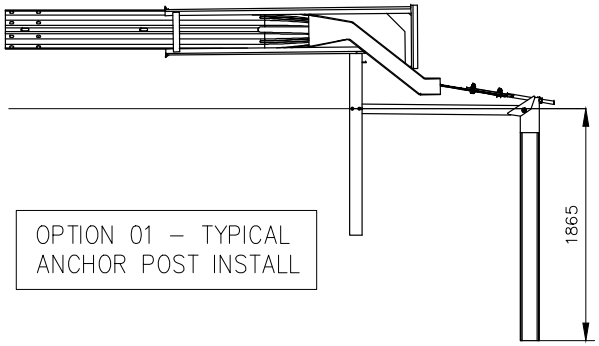
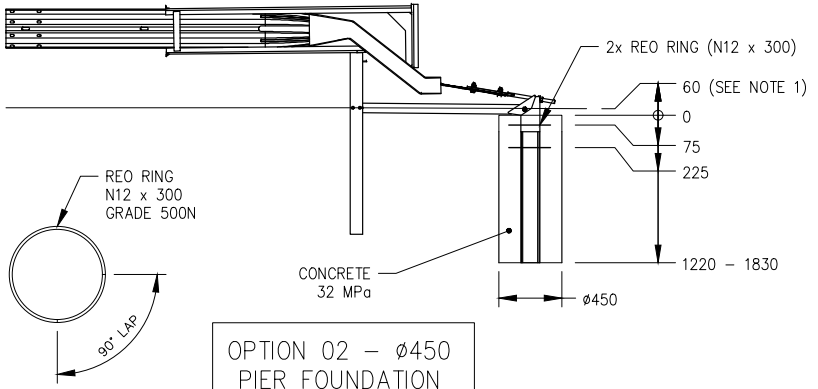
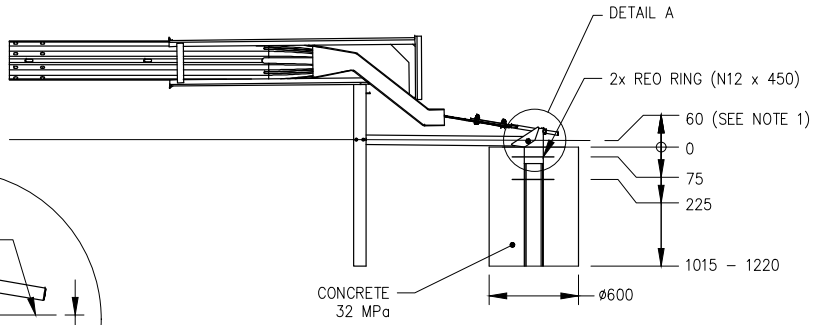


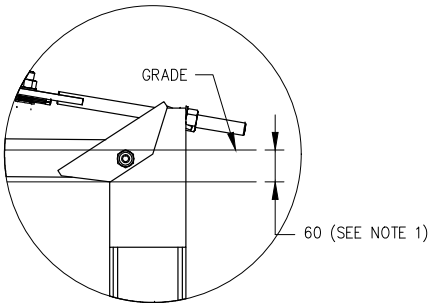
OPTION 01 – TYPICAL
ANCHOR POST INSTALL



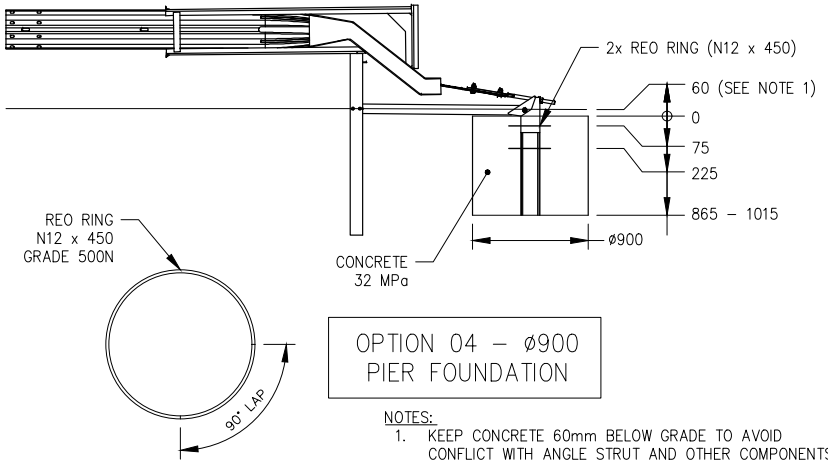
OPTION 02 – ø450
PIER FOUNDATION



OPTION 03 – ø600
PIER FOUNDATION



DETAIL A



OPTION 04 – ø900
PIER FOUNDATION

NOTES:
1. KEEP CONCRETE 60mm BELOW GRADE TO AVOID CONFLICT WITH ANGLE STRUT AND OTHER COMPONENTS.
2. REO RINGS ARE GRADE 500N.
3. MINIMUM STRENGTH OF CONCRETE FOOTING 32 MPa.
4. FAST–CURE CONCRETE MAY BE USED TO ALLOW CONCRETE TO CURE TO A MINIMUM OF 20 MPa PRIOR TO ATTACHING ANCHOR RAIL.
5. ALL DIMENSIONS ARE IN MM.

REVISIONS

REV	DATE	DESCRIPTION	DRAWN	CHECKED	APPROVED
1	19-09-2024	NOTES UPDATED	KZ	HF	KZ

REFERENCES

DRAWING NUMBER	REFERENCE DRAWINGS

	NAME	DATE
DRAWN	VB	11/02/2020
CHECKED		
APPROVED		
SCALE	N.T.S. @ A3	
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PROJECT: ET-SS MASH TERMINAL

INGAL CIVIL PRODUCTS PART No.:

TITLE: ANCHOR POST FOUNDATION OPTIONS

DRAWING No.: SS-STD-010

Rev: 1

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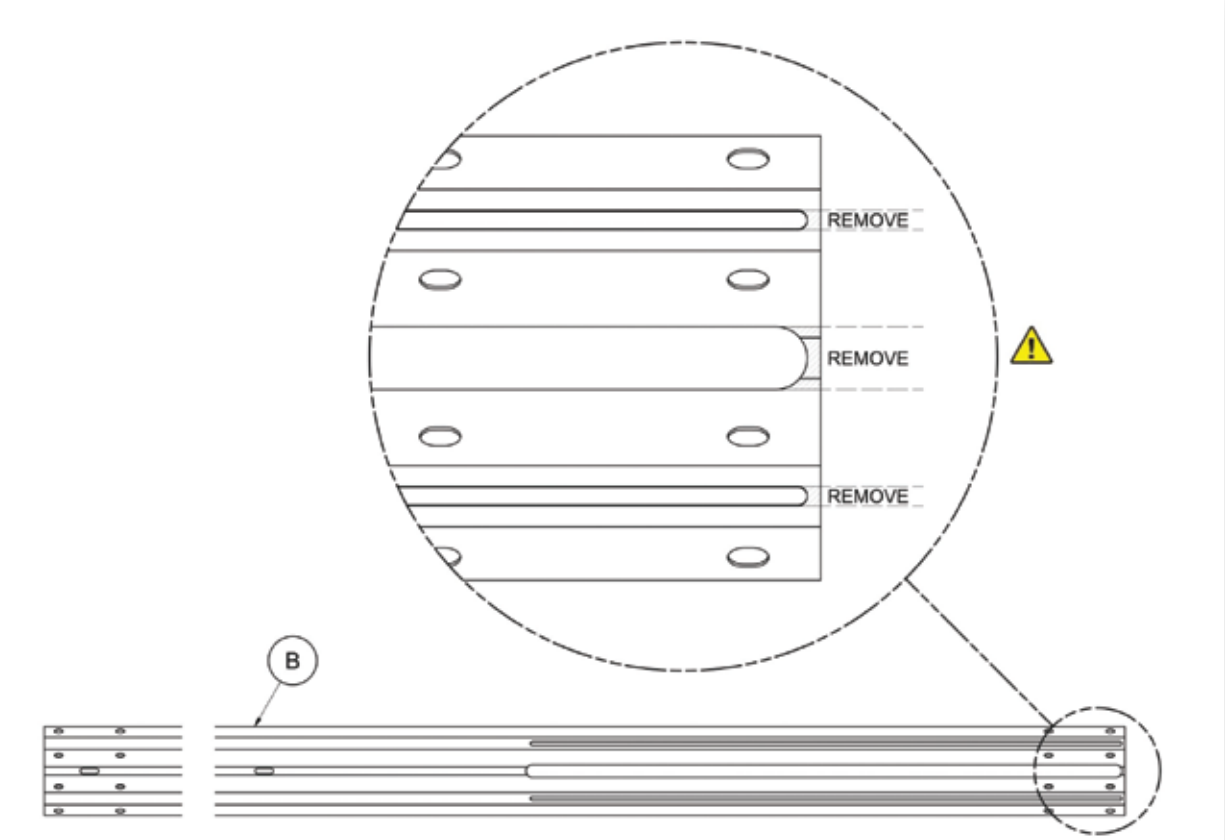
APPENDIX

Offsite Anchor Rail Pre-Assembly Method

Step A: The ET-SS Anchor Rail is manufactured with three (3) shipping tabs. These shipping tabs can be easily removed with an abrasive blade cutting device, or bolt cutters, to assist in the assembly process. It is recommended to make these cuts as neat as possible as this will make the bolting of the cut rails easier.

Note: It is NOT required to remove the shipping tabs. It is permissible to assemble the ET-SS Anchor Rail with flattened tabs, should the contractor desire to do so.

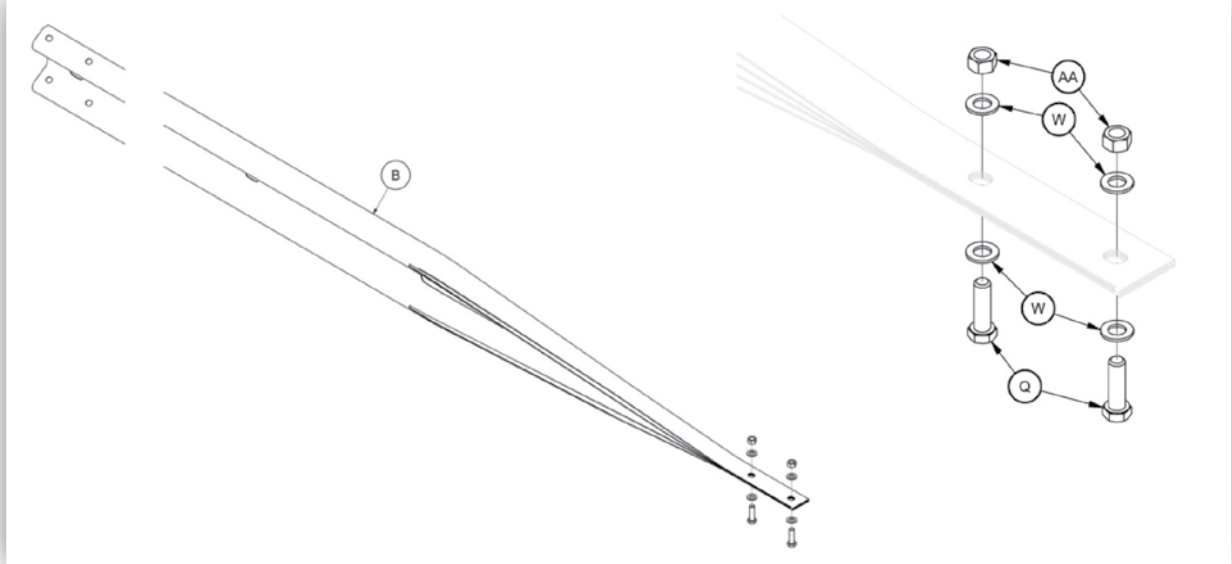
Assembly Tip: For efficiency, make the bottom cut first, moving up the ET-SS Anchor Rail to the top cut.



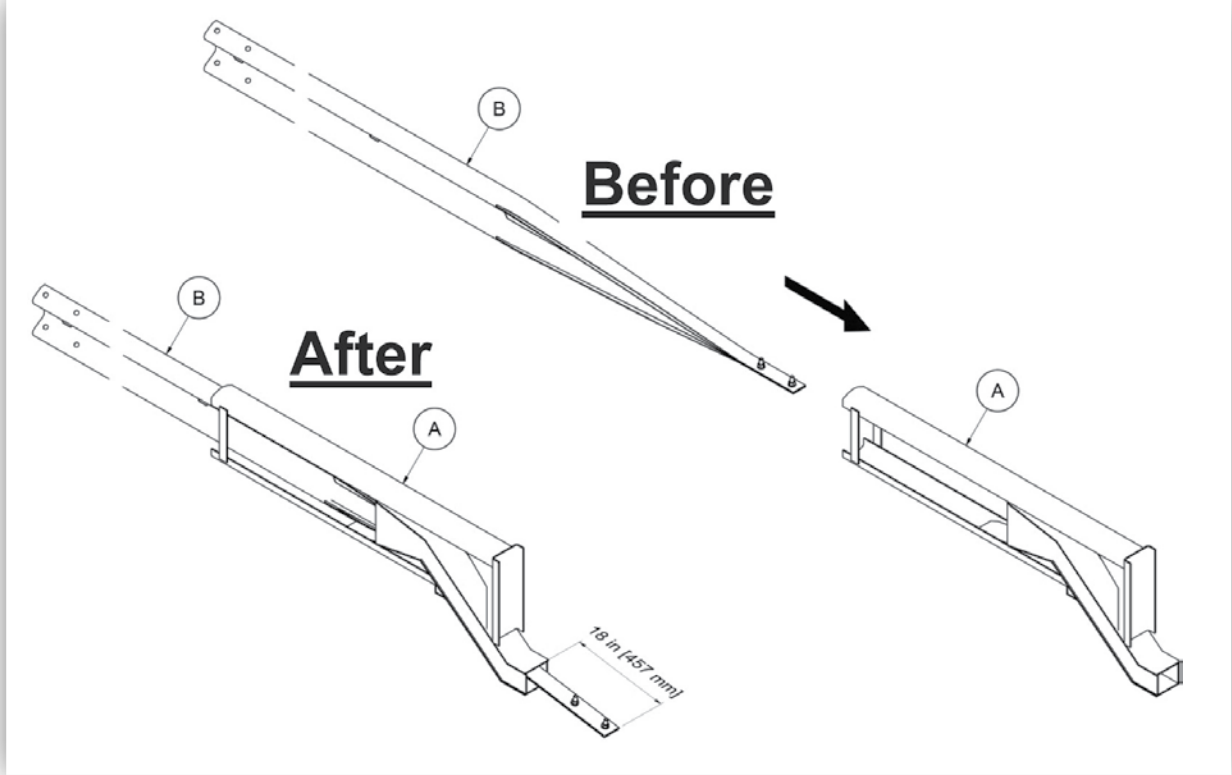
Note: Only one (1) ET-SS Anchor Rail is used per assembly, 3.81m (Part B).

Warning: Keep body parts clear of cutting device. Ensure proper personal protective equipment (PPE) is worn. Failure to follow this warning could result in serious injury or death.

Step B: Assemble all parts in the configuration and orientation shown below. Flatten the (4) plies of the ET-SS Anchor Rail together and insert both hex bolts (Part Q) through the bottom side of the four (4) plies of the ET-SS Anchor Rail (Part B) with washers and nuts (Parts W & AA). The bottom side is determined by the final assembled position of the ET-SS System (nuts are on top side of Anchor Rail). The use of locking pliers or c-clamps will assist the assembly process.



Step C: Feed the flattened slotted end of the SoftStop® Anchor Rail (Part B) into the ET-SS Impact Head (Part A) until approximately 18" [457 mm] of the ET-SS Anchor Rail is protruding out the Chute of the ET-SS Impact Head. This can be achieved by the use of a come-a-long or other mechanical means.



Notes:

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