

TRACC

Crash Attenuation Cushion

Product Manual



Release 08/16

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1.0 Introduction

Crash cushions, also called impact attenuators, prevent errant vehicles from impacting a barrier or fixed object hazard either by gradually decelerating the vehicle, or by redirecting the vehicle away from the hazard.

They are ideally suited for terminating concrete barriers or for use where longitudinal barriers would not be effective to shield objects.

The 2005 TRACC family of crash cushions are fully redirective, non-gating, bi-directional energy absorbing, designed to protect motorists from impacting the end of concrete barriers, toll plazas, bridge piers and other hazards in both temporary and permanent work zone locations.

The 2005 TRACC family includes;

- TRACC – a narrow Test Level 3 cushion
- ShorTRACC – a narrow Test Level 2 cushion
- FasTRACC – a narrow Test Level 3 cushion with additional capacity for head-on impacts up to 110km/h
- WideTRACC – a wide Test Level 3 cushion for any large gore areas

2.0 Crash Performance

All 2005 TRACC products meet the requirements of;

- Australian Standards AS/NZS 3845:1999
- National Cooperative Highway Research Program (NCHRP) Report 350

The systems are designed to perform as follows;

- Redirect side impacts of up to 20° degrees with the axis of the system
- Controlled stopping for impacts at the ends of the system at angles of up to 15°

3.0 Configuration Options

The 2005 TRACC family of crash cushions are available in several configurations as shown in Table 1.

The WideTRACC offers various options in protecting wide hazards and gores. The WideTRACC can be flared down its right side only (R), its left side only (L) or down both sides simultaneously (B).

Table 1: Configuration Options

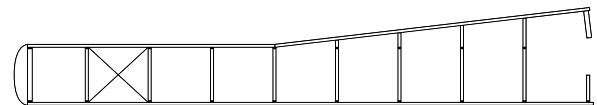
System	Test Level	Width	Length
TRACC	3	610mm	6.5m
ShorTRACC	2	610mm	4.3m
FasTRACC	3+*	610mm	7.9m
WideTRACC - B	3	1470mm**	6.5m**
WideTRACC - L	3	1040mm***	6.5m***
WideTRACC - R	3	1040mm***	6.5m***

* Test Level 3+ indicates that the FasTRACC has been crash tested at 110km/h which exceeds the normal Test Level 3 impact of 100km/h.

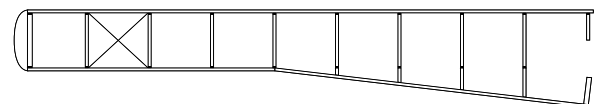
** The width of the WideTRACC – B can be further increased by adding wing extensions on both sides. The extensions will add 710mm of length and 175mm of system width per extension added.

*** The width of the WideTRACC – L and – R can be further increased by adding wing extensions on one side. The extensions will add 710mm of length and 87mm of system width per extension added.

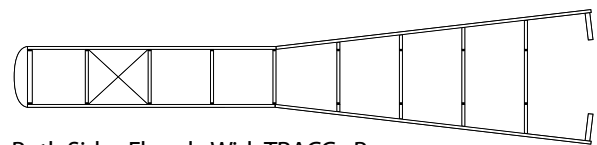
The extensions attached to the rear of the WideTRACC consists of a pair of guardrail panels continuing the height and flare angle of the WideTRACC side panels. The panels are supported by specially designed, braced base-plated posts. The lower panel is further supported by a channel that is installed between the post and the guardrail.



Left Side Flared - WideTRACC - L



Right Side Flared - WideTRACC - R



Both Sides Flared - WideTRACC - B

Figure 1: WideTRACC Configurations

Australian state-specific product acceptance details are available upon request from your local Ingal representative. Acceptance of product variants should be confirmed prior to installation.

4.0 Location Requirements

4.1 Unidirectional Applications

Installation of the TRACC system and its transitions depends on the traffic pattern and the backup structure at the particular location. Unidirectional traffic (one side or both) requires no transition provided the unit is installed beyond the clear zone of opposing traffic. The clear zone is defined as the horizontal width of space available for the safe use of an errant vehicle. The clear zone width is dependent upon traffic volume, speed and road geometry. For opposing traffic the clear zone will take into consideration the width of the median. The backup frame provides a hole pattern allowing attachment to a variety of concrete barrier profiles. Ingal can provide adaptors for non-standard profiles.

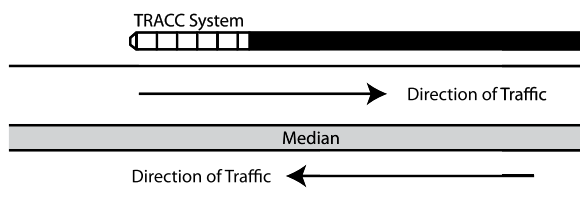


Figure 2: TRACC Located Outside the Clear Zone of Opposing Traffic - No Transition Required

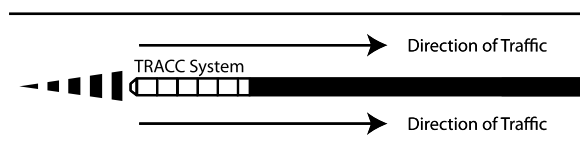


Figure 3: TRACC Located in Gore Area - No Transition Required

4.2 Bidirectional Applications

For installations that face oncoming traffic from the reverse direction, appropriate transitions should be installed on the end of the backup structure to prevent vehicle pocketing.

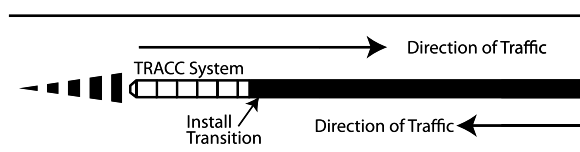


Figure 4: Bidirectional Traffic - Transition Required

4.3 Approach Zone

It is recommended that the TRACC system should not be placed directly behind a raised kerb. The approach area in front of the system should slope at a rate no greater than 10:1 in the direction of traffic flow. The cross slope should be no more than 12:1. The entire length of the TRACC can be used in length-of-need calculations, as it is fully redirective.

4.4 Downstream Zone

The TRACC should be installed so that a 1500mm clear space will exist on both sides of the backup structure for the side panels to retract during an end-on impact.

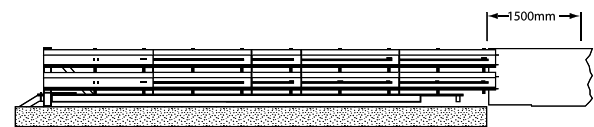


Figure 5: Clear Space Requirement

5.0 Installation Options

5.1 Foundations

During an impact, the stopping force provided by the TRACC is not transferred to the backup structure beyond the cushion. All the stopping loads pass to the foundation below the system through the anchor bolts that attach the system to the foundation. The TRACC can be anchored to a combination of asphalt, concrete and compacted sub base as follows;

Table 2: Foundation Configurations

Foundation Options	Anchor Stud Size
150mm Reinforced Concrete	M16x190mm
200mm Unreinforced Concrete	M16x190mm
75mm Asphalt (min) over 75mm Concrete (min)	M16x460mm
150mm Asphalt (min) over 150mm Compact Sub Base	M16x460mm
200mm Asphalt (min)	M16x460mm

Note: If asphalt is located over a minimum of 150mm concrete, the 460mm anchor studs can be cut off to a length equal to the asphalt thickness plus 190mm. This may eliminate some drilling in locations with thick concrete and relatively thin asphalt overlays.

5.2 Backup Support and Transition Options

The TRACC with its sliding side panels can be attached or transitioned to any backup structure capable of supporting the last frame. If the system has been extended to greater widths as described previously for the WideTRACC, the flared guardrail panels used to create the extra width can be attached to any downstream barrier or structure similar to a standard guardrail connection.

Attachments and transitions are available for the following;

- TRACC Transition to W-Beam Barrier
- TRACC Transition to Thriebeam Barrier
- TRACC Transition to Concrete Barrier

5.3 Nose Delineation Options

The TRACC is intended for use on either the shoulder or median in both unidirectional and bidirectional traffic situations. TRACC units are supplied with four pieces of delineation tape that can be customised to create the three designs as shown below. The plastic nose cone should be attached to the front of the TRACC using the side panel attachment hardware already located on the system.

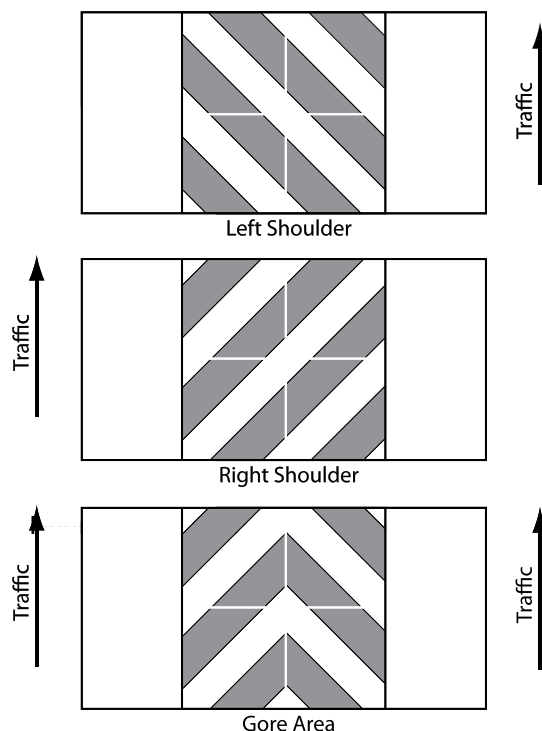
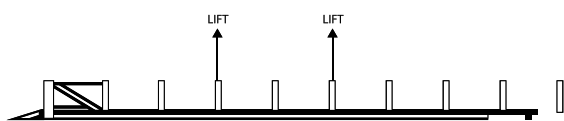


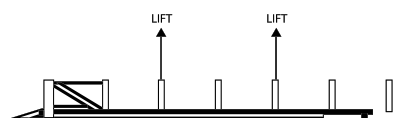
Figure 6: Nose Delineation Options

6.0 Installation of the System

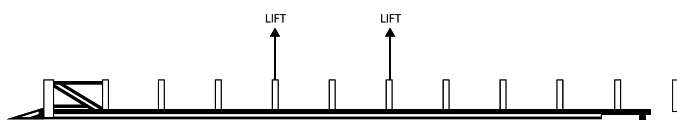
Only items supplied by Ingal Civil Products are to be used for the installation of the TRACC systems. A Safe Work Method Statement is available upon request for installation operations.



Recommended lifting points for 6.4m TRACC and WideTRACC



Recommended lifting points for 4.3m ShorTRACC



Recommended lifting points for 7.9m FasTRACC

6.1 Lifting the System

TRACC units are delivered pre-assembled to site to facilitate rapid installation and minimise disruption to traffic flow.

TRACC systems can be lifted as complete units by threading lifting chains or slings directly through the tops of the frames.

6.2 Anchoring the System

TRACC systems can be installed on combinations of asphalt and concrete. Table 2 contains the type of anchors required depending upon the foundation type. Holes should be drilled 40mm less than the overall length of the anchor stud to ensure proper embedment.

TRACC systems can be placed directly onto the foundation as a complete unit. The system should be aligned with the downstream barrier according to the approach and downstream zone requirements as detailed in Section 4.0.

Holes for the anchor studs can be drilled into the foundation using the system as a template. Due to the open design of all the TRACC systems including the WideTRACC, it is not necessary to disassemble any portion of the system in order to drill the anchoring holes. Note that the flared section of the WideTRACC requires additional outboard anchors that have been packaged loose and must also be anchored to the foundation. Refer to the WideTRACC drawings for the location of these outboard anchors.

Once the anchor holes have been drilled and are free from dust and moisture, the anchor adhesive can be dispensed into the hole and the anchor stud should be suspended by its nut and washer through the crosstie. The stud should hang in the uncured adhesive with no threads showing above the nut. Final tightening should occur once the adhesive has fully cured. Refer to the adhesive instructions printed on the cartridges for curing times under various environmental conditions.

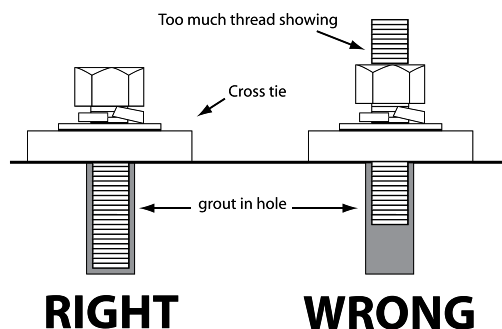


Figure 7: Anchor Stud Arrangement

6.3 Attachment of Backups and Transitions

The last support frame on a TRACC system must be connected to a rigid object in order to support the side panels and any required transition panels. While no direct stopping forces are transmitted onto the backup support structure during an end-on impact, the backup structure may be required to provide support during redirecting impacts. Please refer to Ingal Civil Products drawings or consult with Ingal representatives to ensure an appropriate connection is achieved.

7.0 Repair after Impact

TRACC systems are not disposable systems. Complete replacement on the roadside after impacts is a convenient way of protecting workers by limiting exposure to traffic. Up to 98% of the TRACC is reusable after design impacts.

7.1 Repair Options

The energy absorbing portions of the base assembly of the TRACC system can be replaced in stages depending on the extent of the impact. Since TRACC systems are delivered fully assembled, the damaged system is replaced entirely with all repairs performed accurately in the safety of an Ingal workshop. Many of a TRACC system's components remain undamaged after design impacts making refurbishment simple and economical.

7.2 Types of Damage

TRACC systems are designed to withstand end-on impacts and redirecting side impacts. Side impacts, depending on the severity, may only cause cosmetic damage to the system. Any system that has been impacted along its side should be examined to ensure that any damage that may hinder the operational performance of the system is repaired.

During some severe, high-speed, redirecting impacts with heavy vehicles, a TRACC system may become permanently twisted. If the deformation at the base causes a portion of one side of the system to be raised more than 40mm when compared to the other side of the system, then the damaged portion of the base assembly will require replacement.

7.3 Bush Fire Damage

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.

The nose piece is made from a composite polymer and may deform due to the heat exposure from the fire, if any deformation is evident, the component shall be replaced.

7.4 Field Repair

Field repair is to be limited to minor end-on impacts that stroke the system less than 1350mm. In these circumstances, the sled is to be pulled out to its original position. If there exists additional damage, then the unit is to be removed with all repairs undertaken in the safety of an Ingal workshop.

7.5 Removal of System

The TRACC can be removed from its foundation by releasing the anchor nuts that secure the crossties. Flat wrenches may be required to access the anchor studs under the displaced frames and sled. Once released, the system can be lifted as a unit and transported back to the workshop for repair. A new or reconditioned TRACC can be positioned on the existing anchor studs and firmly attached using the appropriate nuts and washers.

If damage to an anchor stud occurs, it will be necessary to remove the old anchor, drill out the adhesive in the old hole and replace the removed anchor with a new anchor and adhesive.



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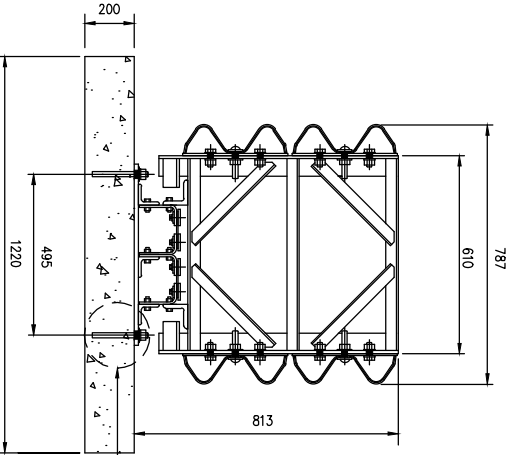
INGAL CIVIL PRODUCTS
 57-58 Morda Road, Morda, NSW, 2556, Australia
 Telephone 61-2-9827 2323, Fax 61-2-9827 2300, Email: info@ingalcivil.com.au
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PROJECT: TL3 TRACC SYSTEM

TITLE: PLAN, ELEVATION & SECTION

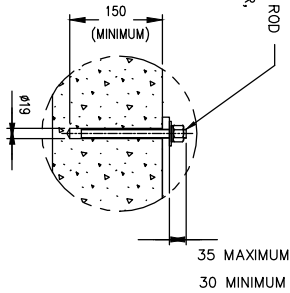
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CHECKED	T.C.	
MATERIAL	AS SHOWN	DRAWING No.
FINISH	HD GALV	CAB-STD-080
SCALE	N.T.S.	REV.0

SECTION "A-A"



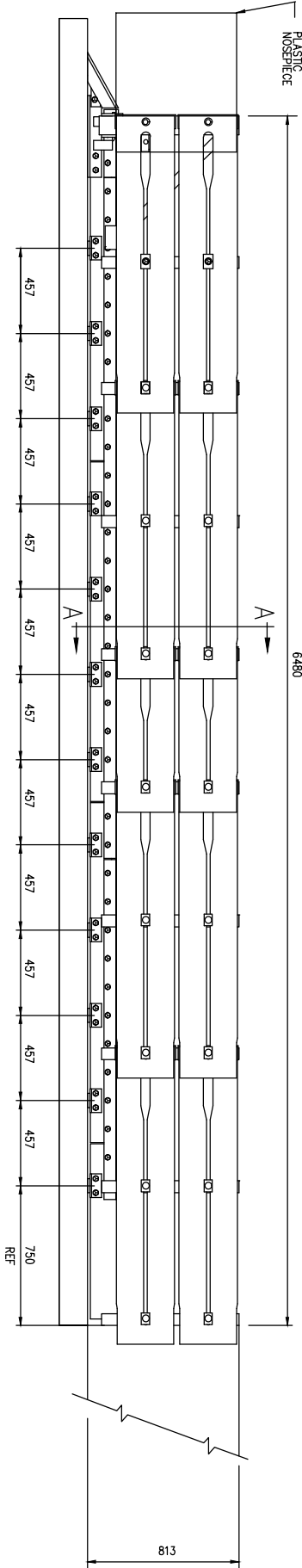
M16 x 190 ALL THREADED ROD
 WITH SPRING LOCK WASHER,
 FLAT WASHER & HEX NUT
 SECURING TRACC UNIT TO
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 (26 OFF)

DETAIL B

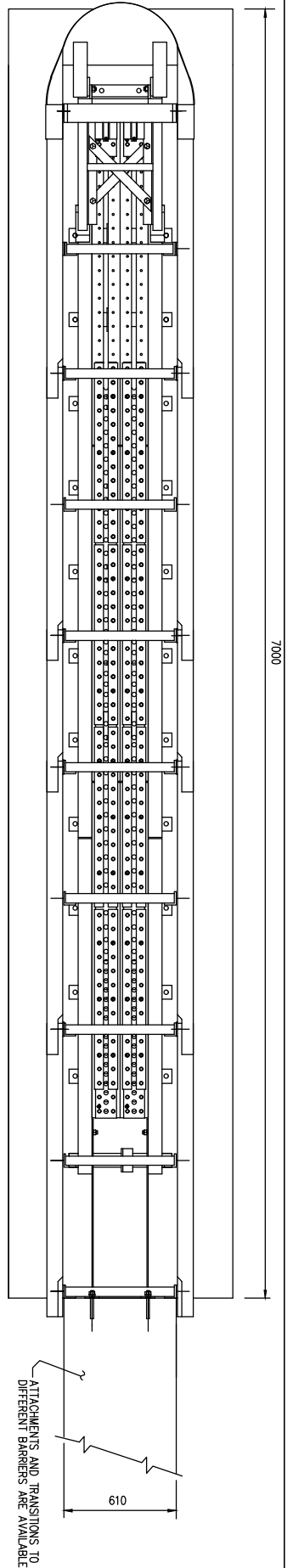


- Notes:
- 200mm UNREINFORCED CONCRETE PAD IS SHOWN.
 - OTHER OPTIONS ARE:
 - 1. 150mm REINFORCED CONCRETE
 - 2. 200mm ASPHALT (MIN)
 - 3. 75mm ASPHALT (MIN) OVER 75mm CONCRETE (MIN)
 - 4. 150mm ASPHALT (MIN) OVER COMPACTED SUB-BASE
 - THIS TRACC CRASH ATTENUATOR HAS BEEN APPROVED BY THE U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION AS CONFORMING TO NORTH 350 TEST LEVEL 3. THIS REPORT HAS BEEN ADOPTED AS THE BASIS OF TESTING FOR AS/NZS 3845-1999 ROAD SAFETY BARRIER SYSTEMS.
 - MATERIAL GALVANISED TO CONFORM TO AS/NZS4680-2006 "HOT-DIP GALVANIZED (ZINC) COATINGS ON FABRICATED FERROUS ARTICLES."

ELEVATION



PLAN

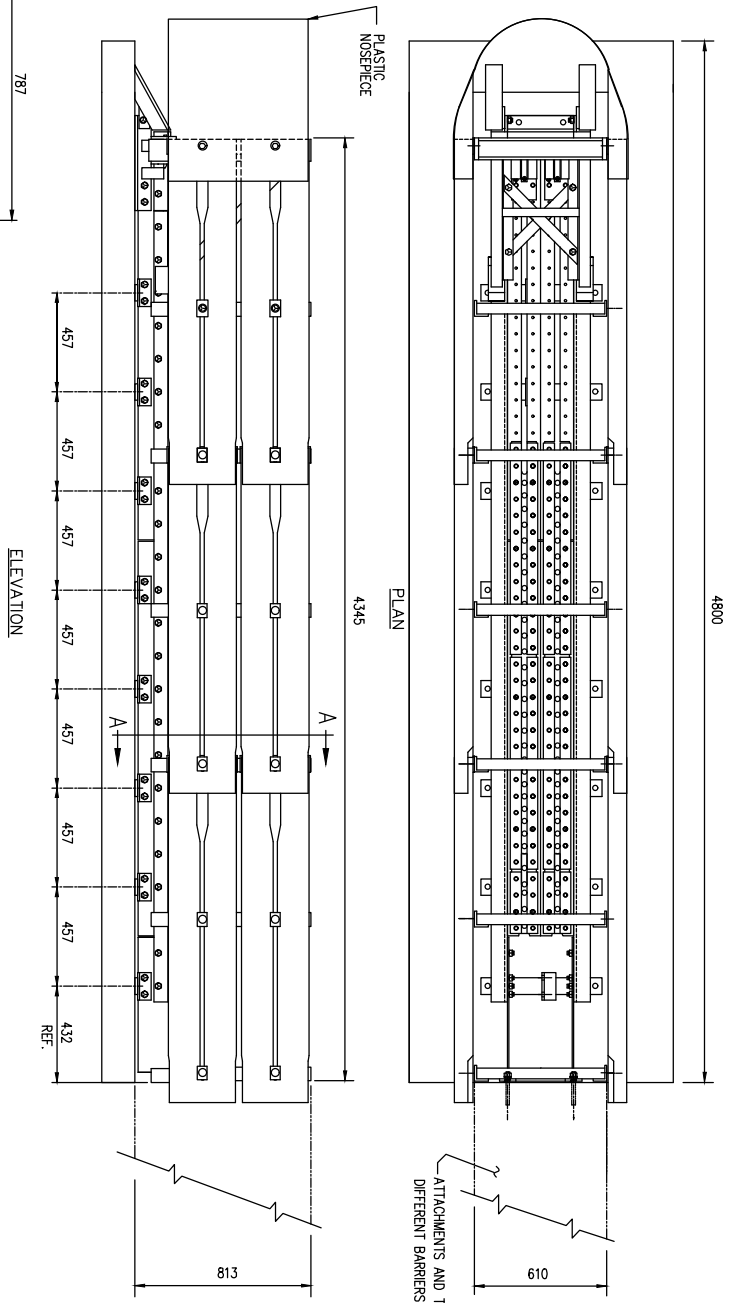
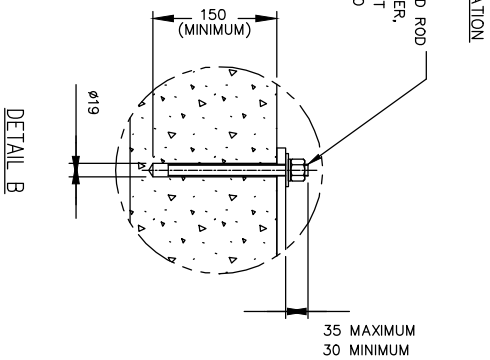
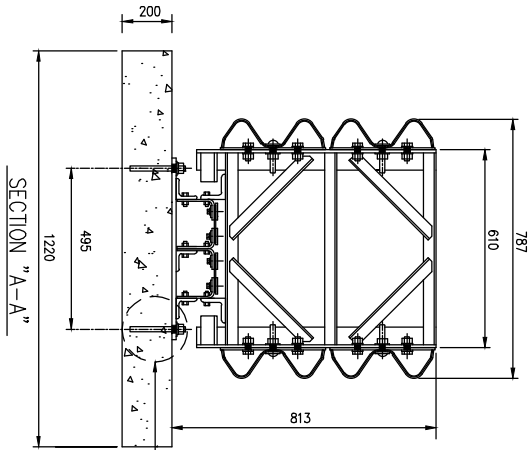


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PROJECT	TL2 SHORTTRAC SYSTEM
TITLE	PLAN, ELEVATION & SECTION

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DRAWN	M.S.	REFERENCE NO.
CHECKED	T.C.	C3032
MATERIALS AS SHOWN		DRAWING NO.
FINISH	HD GALV	CAB-STD-081
SCALE	N.T.S.	REV.0



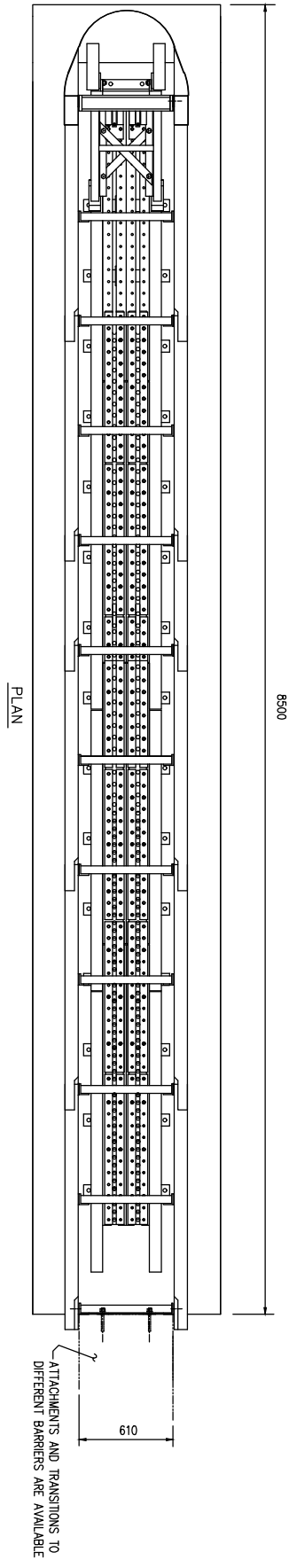
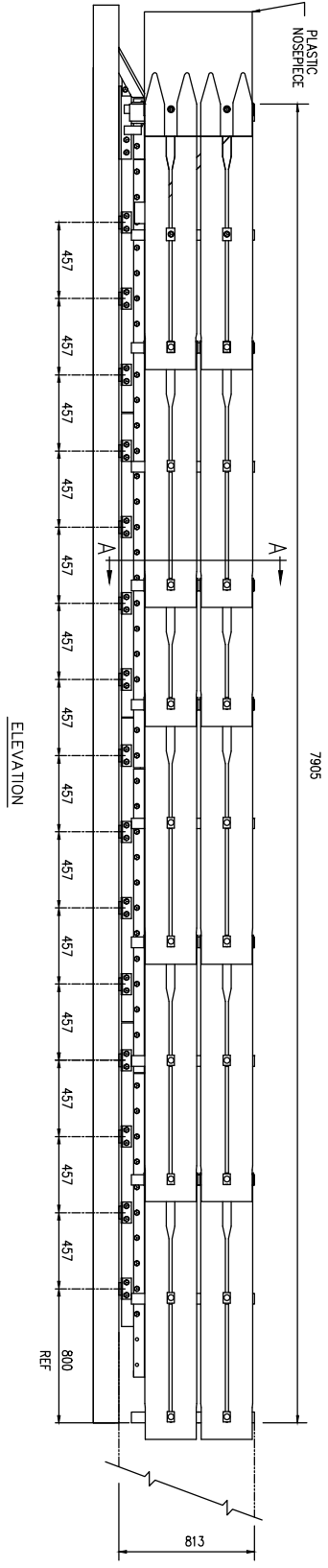
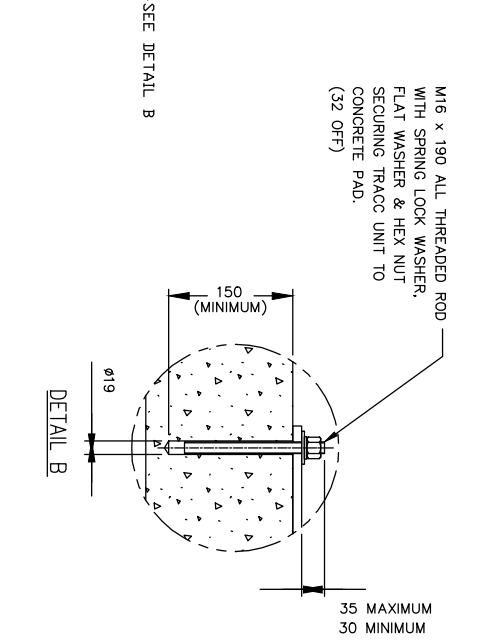
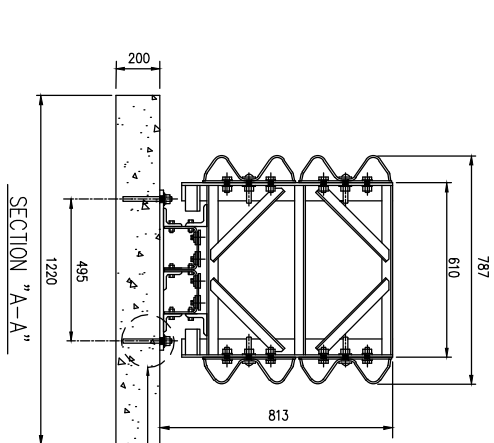
- Notes:**
- 200mm UNREINFORCED CONCRETE PAD IS SHOWN.
 - OTHER OPTIONS ARE:
 - 1. 150mm REINFORCED CONCRETE
 - 2. 200mm ASPHALT (MIN)
 - 3. 75mm ASPHALT (MIN) OVER 75mm CONCRETE (MIN)
 - 4. 150mm ASPHALT (MIN) OVER COMPACTED SUB-BASE
 - THIS TRAC CRASH ATTENUATOR HAS BEEN APPROVED BY THE U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION AS CONFORMING TO NCHRP 350 TEST LEVEL 2. THIS REPORT HAS BEEN ADOPTED AS THE BASIS OF TESTING FOR AS/NZS 3845-1999 "ROAD SAFETY BARRIER SYSTEMS".
 - MATERIAL GALVANISED TO CONFORM TO AS/NZS4680-2006 "HOT-DIP GALVANIZED (ZINC) COATINGS ON FABRICATED FERROUS ARTICLES".

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PROJECT	TL3+ FASTRACC SYSTEM
TITLE	PLAN, ELEVATION & SECTION
DATE	03/08/09
DRAWN	M.S.
CHECKED	T.C.
MATERIALS	AS SHOWN
FINISH	HD GALV
SCALE	N.T.S.
DRAWING NO.	CAB-STD-082
REV	REV 0



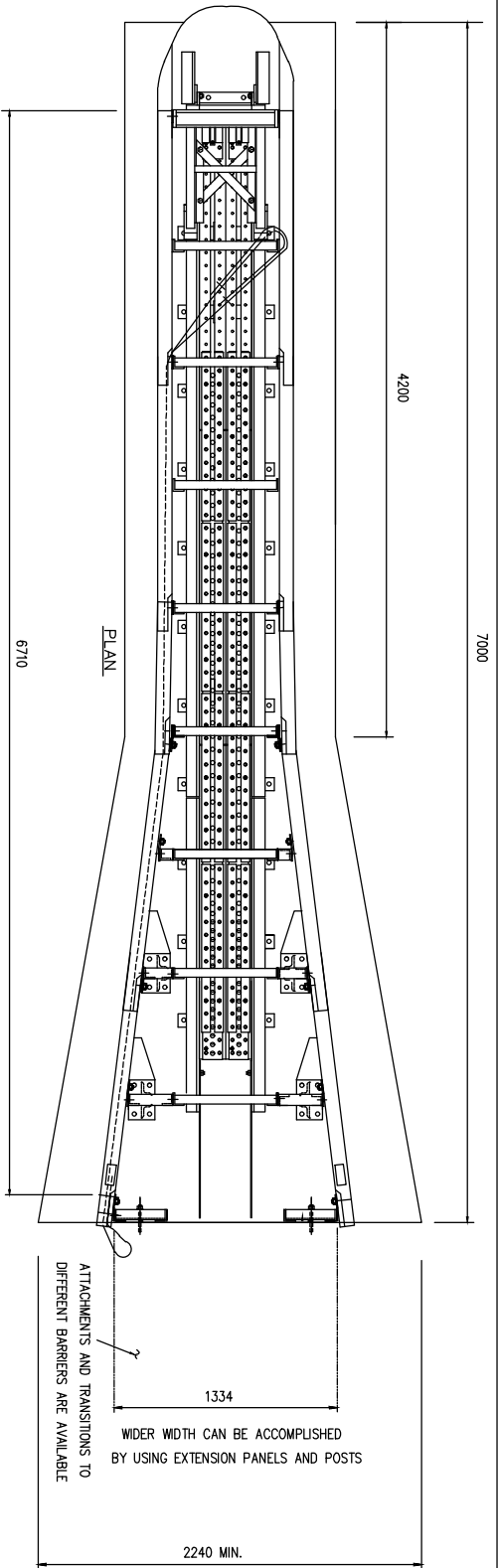
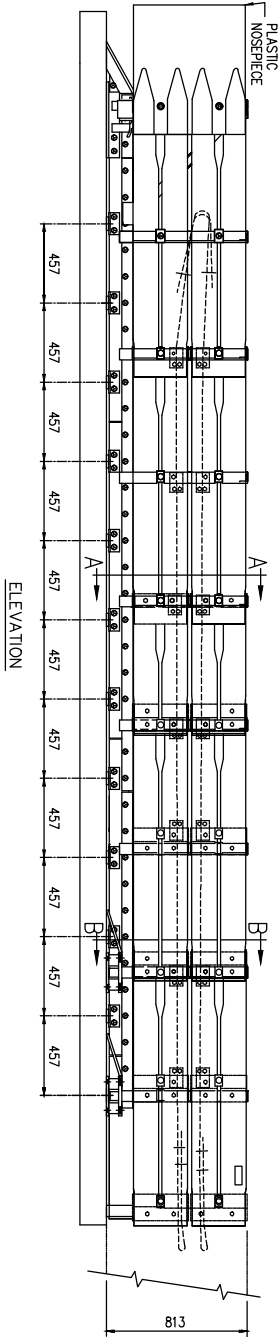
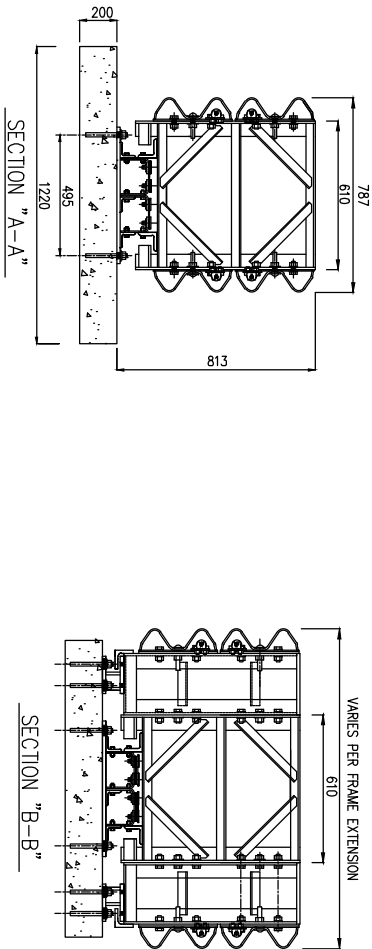
- Notes:
- 200mm UNREINFORCED CONCRETE PAD IS SHOWN.
 - OTHER OPTIONS ARE:
 1. 150mm REINFORCED CONCRETE
 2. 200mm ASPHALT (MIN) OVER 75mm CONCRETE (MIN)
 3. 75mm ASPHALT (MIN) OVER 75mm CONCRETE (MIN)
 4. 150mm ASPHALT (MIN) OVER COMPACTED SUB-BASE
 - TEST LEVEL 3+ REFERS TO THE FACT THAT THIS TRACC HAS BEEN TESTED FOR CONDITIONS THAT EXCEED NORMAL TEST LEVEL 3. TESTING INCLUDED A 2000KG VEHICLE IMPACTING AT ZERO DEGREES AT 112KM/H
 - MATERIAL GALVANISED TO CONFORM TO AS/NZS4680-2006 "HOT-DIP GALVANIZED (ZINC) COATINGS ON FABRICATED FERROUS ARTICLES."

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PROJECT	1330mm WIDETRACC SYSTEM	DATE	03/08/09	INGAL CIVIL PRODUCTS
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				DRAWING NO.
				CAB-STD-083
				REV.0



- Notes:
- 200mm UNREINFORCED CONCRETE PAD IS SHOWN.
 - OTHER OPTIONS ARE:
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 2. 200mm ASPHALT (MIN)
 3. 75mm ASPHALT (MIN) OVER 75mm CONCRETE (MIN)
 4. 150mm ASPHALT (MIN) OVER COMPACTED SUB-BASE
 - THIS TRACC CRASH ATTENUATOR HAS BEEN APPROVED BY THE U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION AS CONFORMING TO NCHRP 350 TEST LEVEL 3. THIS REPORT HAS BEEN ADOPTED AS THE BASIS OF TESTING FOR AS/NZS 3845-1999 ROAD SAFETY BARRIER SYSTEMS.
 - MATERIAL GALVANISED TO CONFORM TO AS/NZS4680-2006 "HOT-DIP GALVANIZED (ZINC) COATINGS ON FABRICATED FERROUS ARTICLES."

Rev	Description	MS	Date
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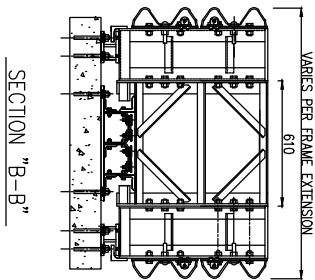
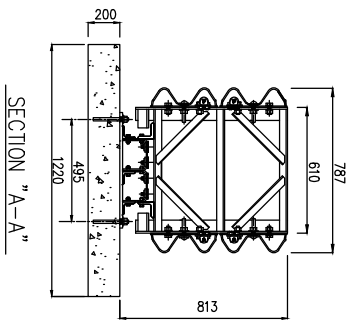
INGAL CIVIL PRODUCTS

PROJECT 1470mm WIDETRACC SYSTEM

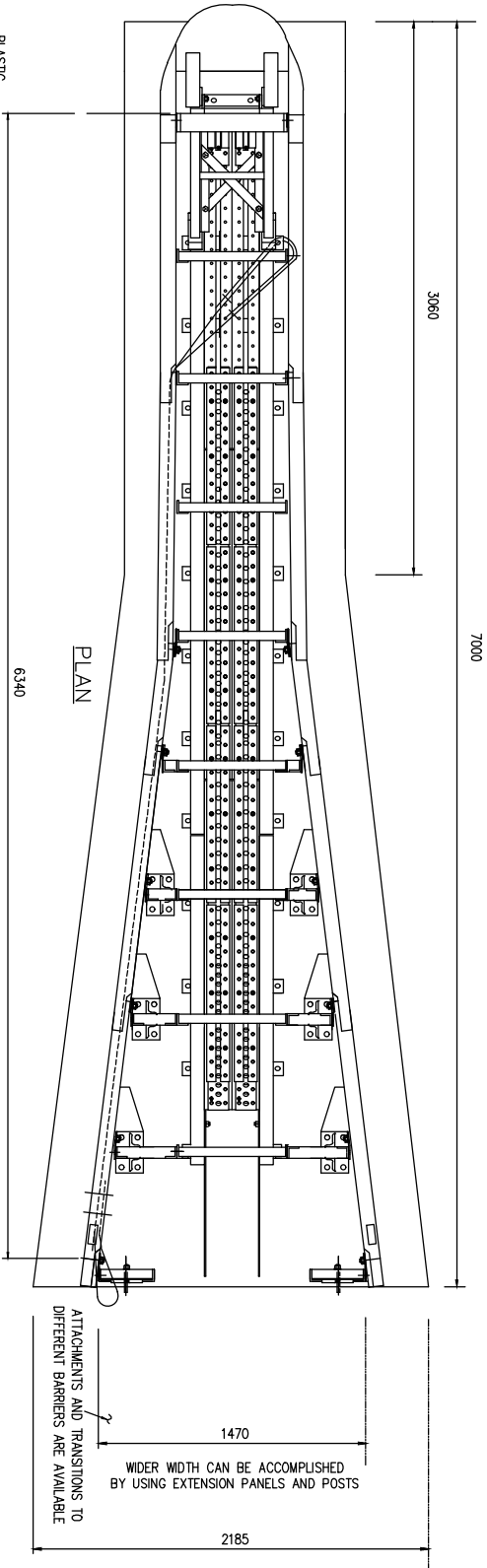
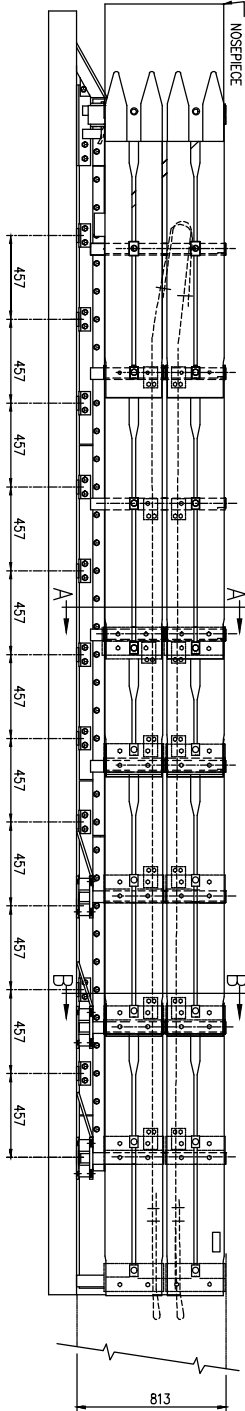
TITLE PLAN, ELEVATION & SECTION

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DESIGNED	TRINITY IND.	
CHECKED	T.C.	
MATERIALS SHOWN		
FINISH	H/D GALV	
SCALE	N.T.S.	

DRAWING No.
CAB-STD-084
REV.0



ELEVATION



- Notes:
- 200mm UNREINFORCED CONCRETE PAD IS SHOWN.
 - OTHER OPTIONS ARE:
 1. 150mm REINFORCED CONCRETE
 2. 200mm ASPHALT (MIN)
 3. 75mm ASPHALT (MIN) OVER 75mm CONCRETE (MIN)
 4. 150mm ASPHALT (MIN) OVER COMPACTED SUB-BASE
 - THIS TRACC CRASH ATTENUATOR HAS BEEN APPROVED BY THE U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION AS CONFORMING TO NCHRP 350 TEST LEVEL 3. THIS REPORT HAS BEEN ADOPTED AS THE BASIS OF TESTING FOR AS/NZS 3845-1999 "ROAD SAFETY BARRIER SYSTEMS".
 - MATERIAL GALVANISED TO CONFORM TO AS/NZS4680-2006 "HOT-DIP GALVANIZED (ZINC) COATINGS ON FABRICATED FERROUS ARTICLES".

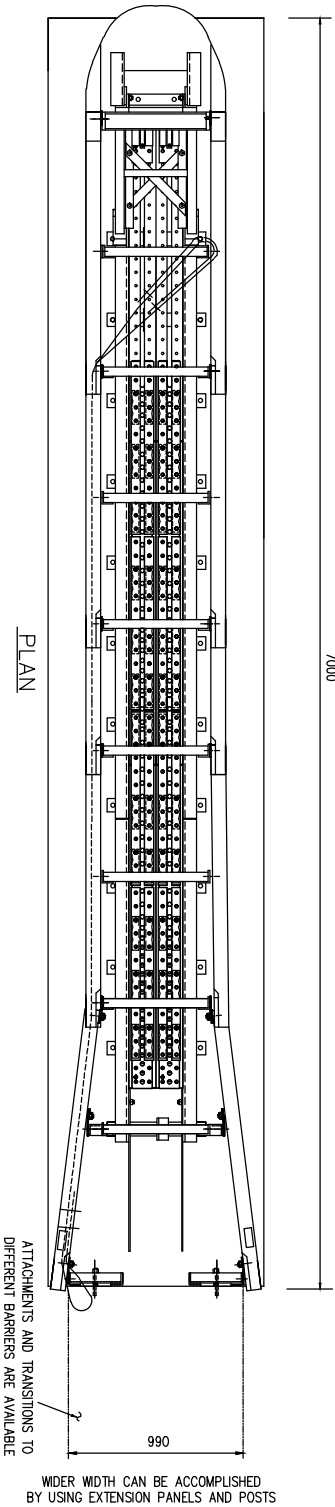
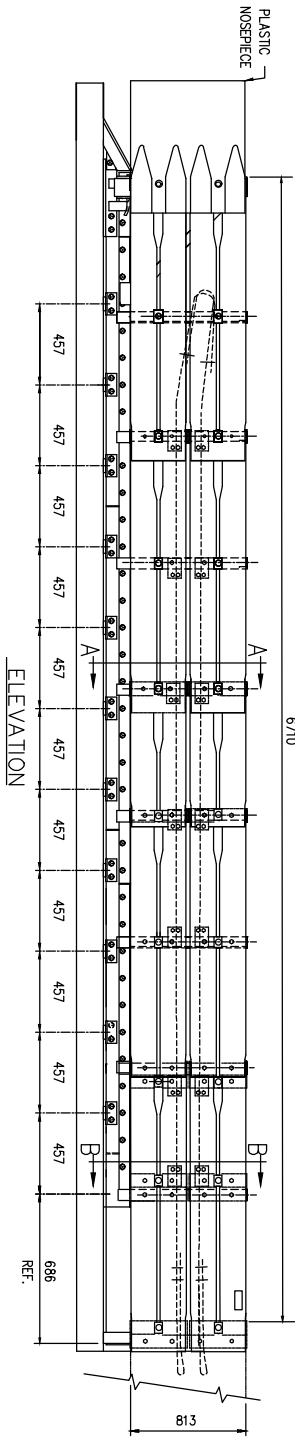
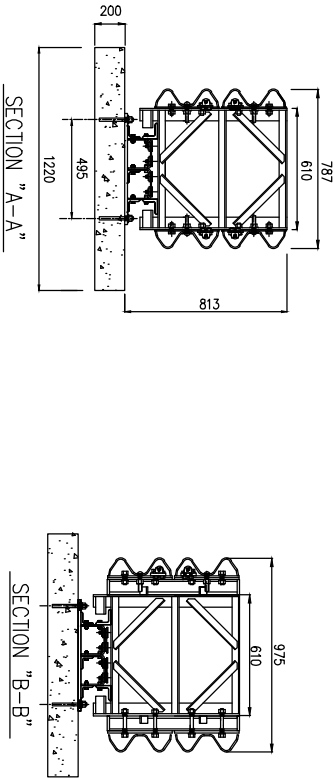
ATTACHMENTS AND TRANSITIONS TO
DIFFERENT BARRIERS ARE AVAILABLE

WIDER WIDTH CAN BE ACCOMPLISHED
BY USING EXTENSION PANELS AND POSTS

Rev	Description	Chkd	Date
0	INITIAL ISSUE	MS	03/08/09



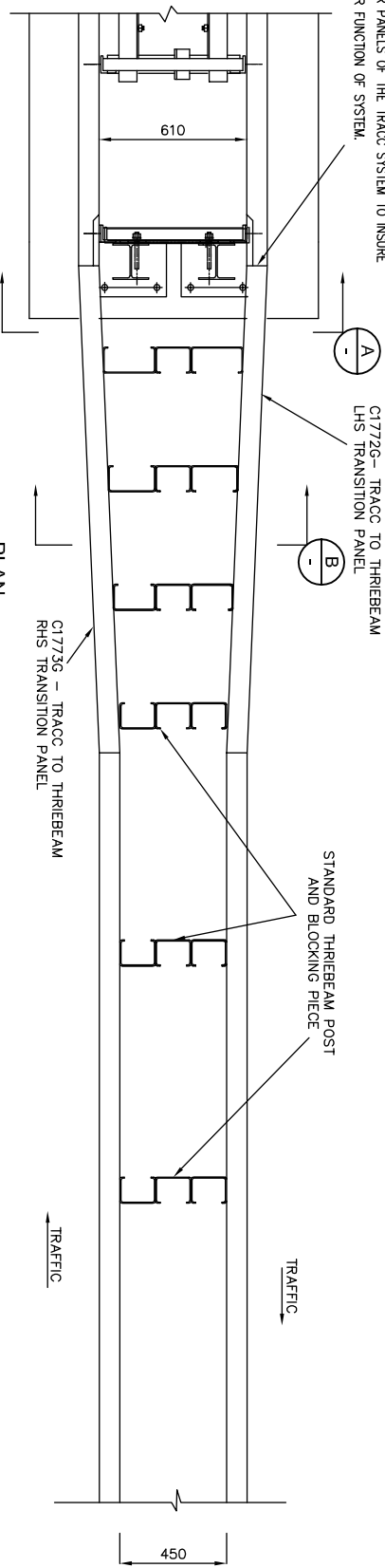
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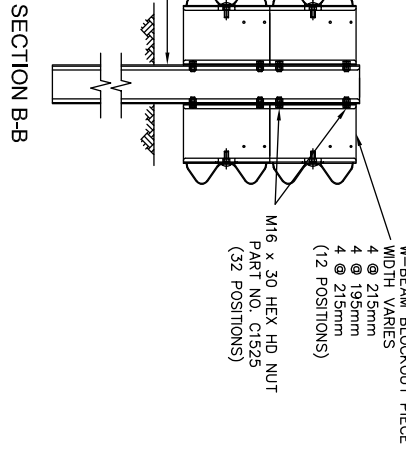
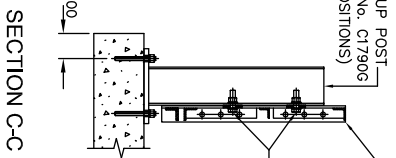
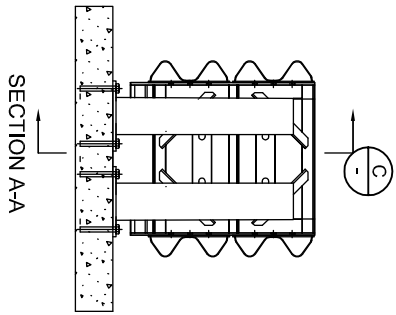
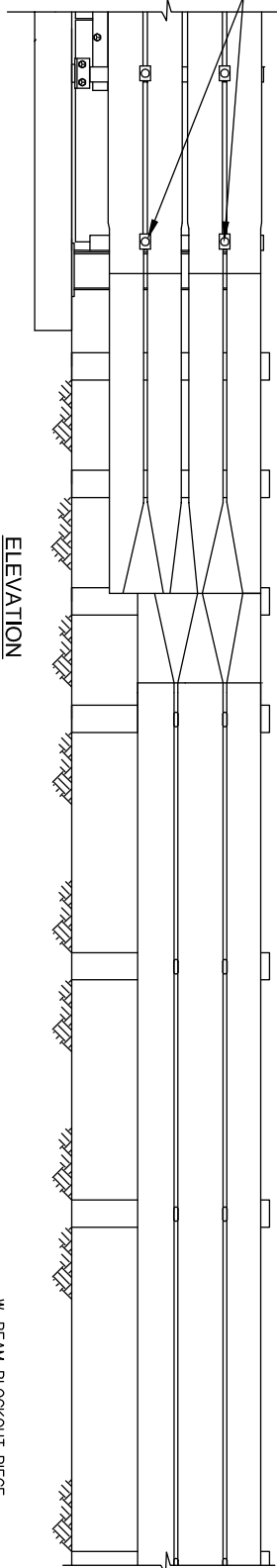
- Notes:
- 200mm UNREINFORCED CONCRETE PAD IS SHOWN.
 - OTHER OPTIONS ARE:
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 2. 200mm ASPHALT (MIN)
 3. 75mm ASPHALT (MIN) OVER 75mm CONCRETE (MIN)
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 - THIS TRAC CRASH ATTENUATOR HAS BEEN APPROVED BY THE U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION AS CONFORMING TO NCRRP 350 TEST LEVEL 3. THIS REPORT HAS BEEN ADOPTED AS THE BASIS OF TESTING FOR AS/NZS 3845-1999 "ROAD SAFETY BARRIER SYSTEMS".
 - MATERIAL GALVANISED TO CONFORM TO AS/NZS4680-2006 "HOT-DIP GALVANIZED (ZINC) COATINGS ON FABRICATED FERROUS ARTICLES".

PROJECT	990mm WIDETRACC SYSTEM	DATE	03/08/09	INGAL CIVIL PRODUCTS
TITLE	PLAN, ELEVATION & SECTION	DRAWN	M.S.	REFERENCE NO.
		DESIGNED	FRITTY IND.	
		CHECKED	T.C.	
		MATERIALS	SHOWN	DRAWING No.
		FINISH	HD GALV	CAB-STD-085
		SCALE	N.T.S.	REV.0

TO INSTALL TRANSITION PANELS
THE TRANSITION PANELS MUST BE PLACED BEHIND THE
FENDER PANELS OF THE TRACC SYSTEM TO INSURE
PROPER FUNCTION OF SYSTEM.



REMOVE M16 x 50 SPLICE BOLT
SUPPLIED WITH TRACC UNIT & INSTALL
M16 x 65 CONNECTING BOLT
(2 POSITIONS THIS SIDE &
2 POSITIONS OPPOSITE SIDE)



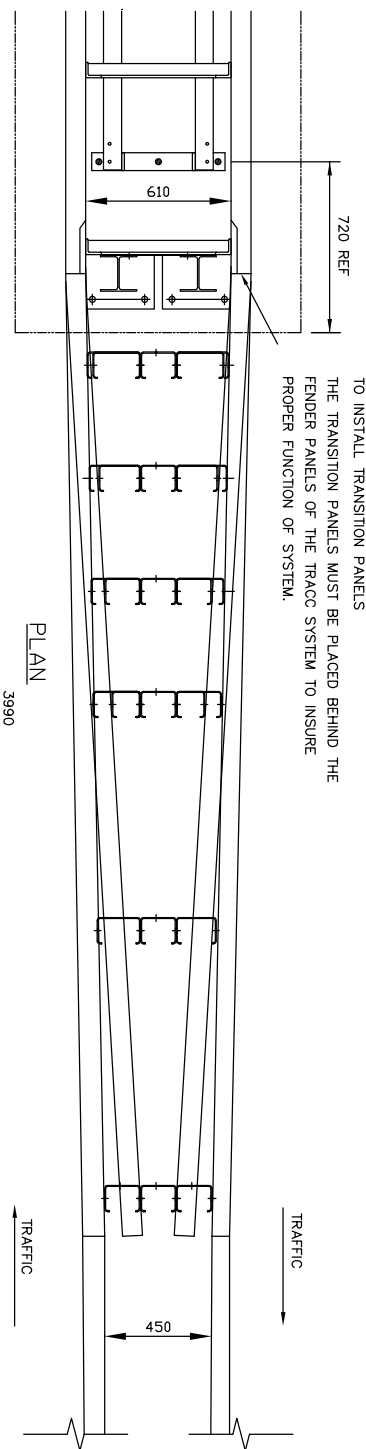
Rev	INITIAL	ISSUE	Description	Chkd	Date
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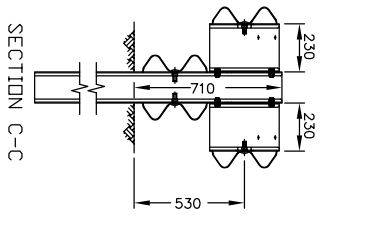
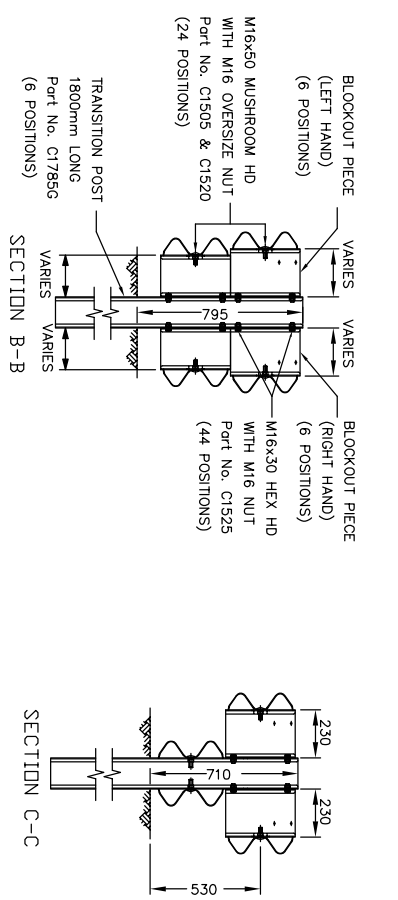
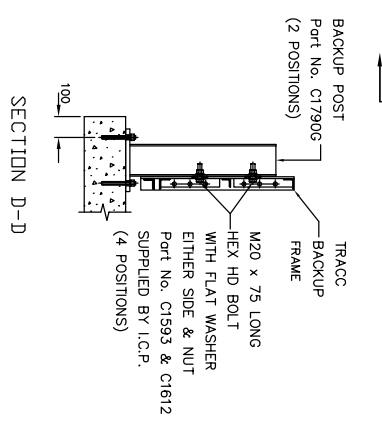
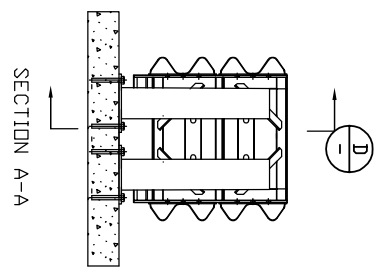
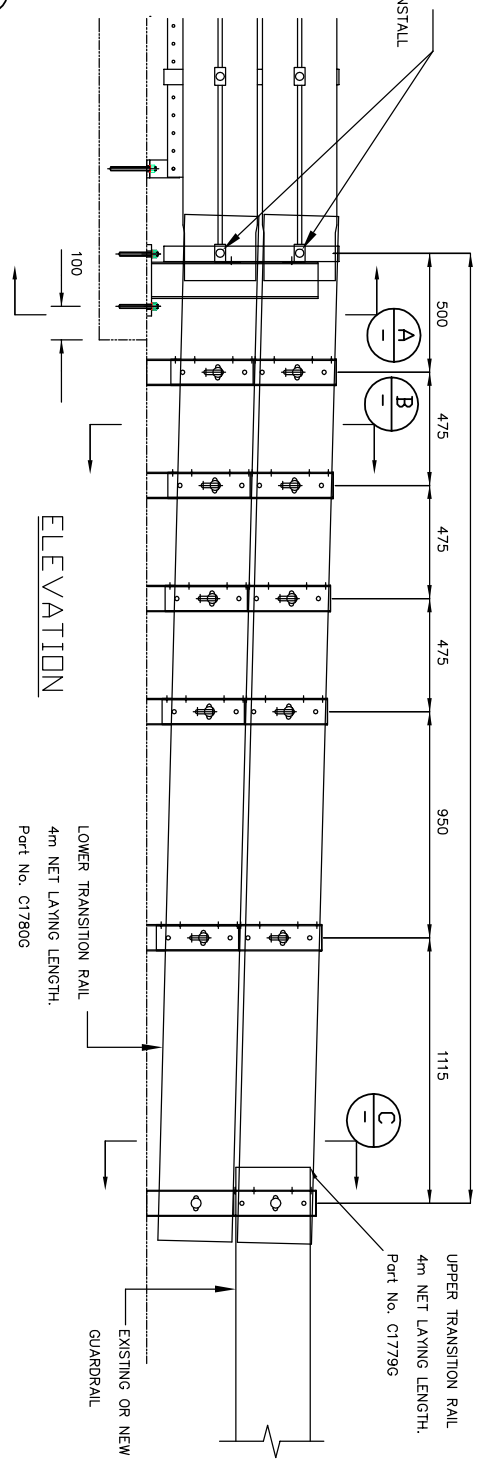
PROJECT	TRACC TRANSITION TO THRIEBEAM ASSEMBLY
TITLE	GENERAL ARRANGEMENT

DATE	03/08/09	INGAL CIVIL PRODUCTS
DRAWN	MS	REFERENCE No.
CHECKED	T.C.	DRAWING No.
MATERIALS	SHOWN	CAB-STD-091
FINISH	AS SHOWN	REV.0
SCALE	N.T.S.	

TO INSTALL TRANSITION PANELS
THE TRANSITION PANELS MUST BE PLACED BEHIND THE
FENDER PANELS OF THE TRACC SYSTEM TO INSURE
PROPER FUNCTION OF SYSTEM.



REMOVE M16 x 50 SPLICE BOLT
SUPPLIED WITH TRACC UNIT & INSTALL
M16 x 65 CONNECTING BOLT
(2 POSITIONS THIS SIDE &
2 POSITIONS OPPOSITE SIDE)



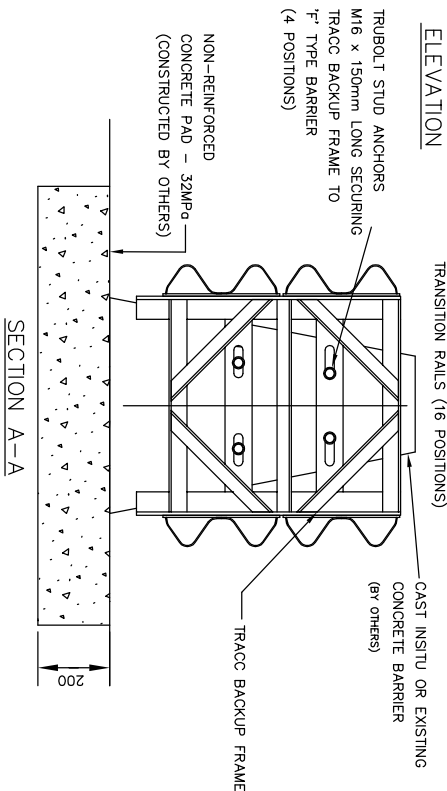
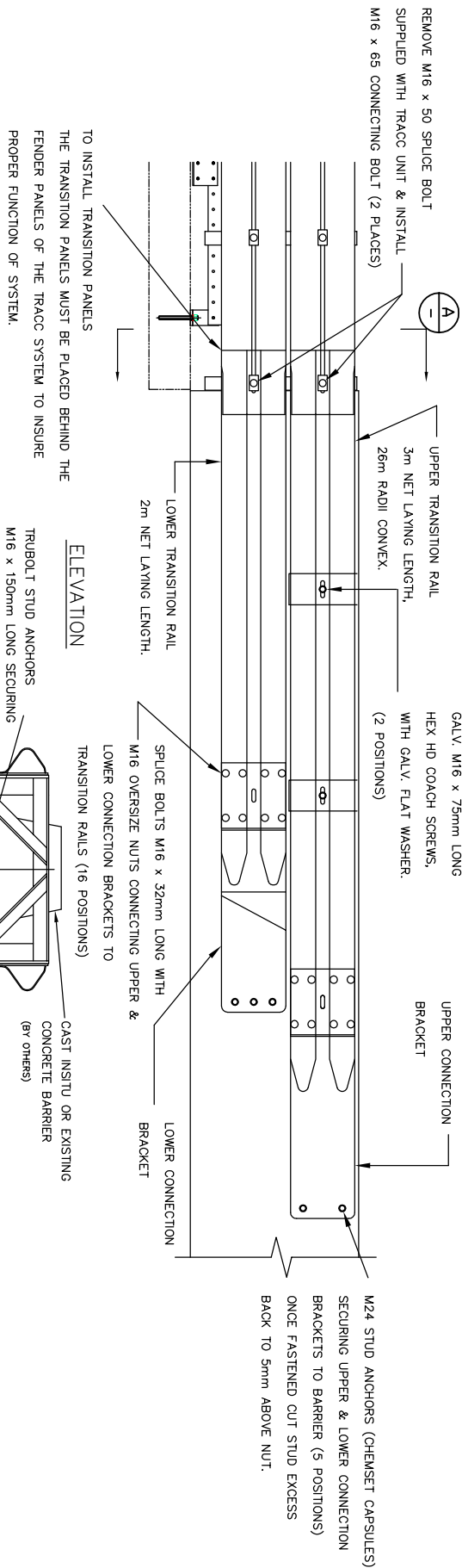
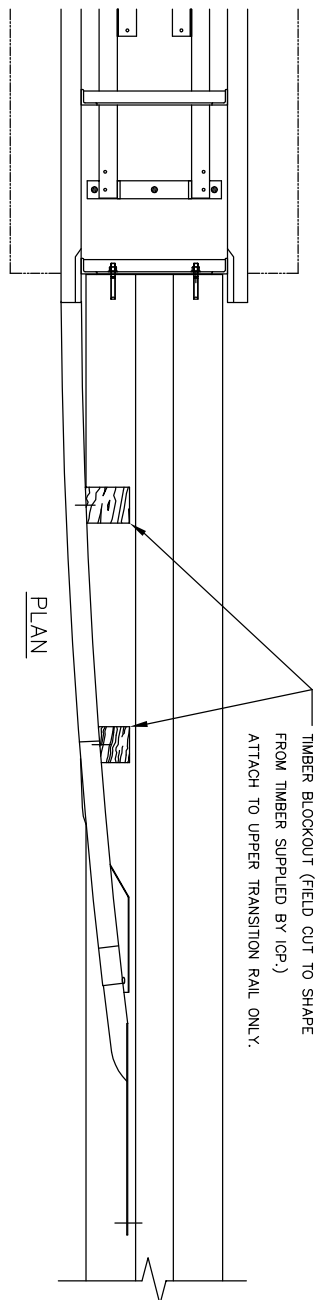
Rev	INITIAL ISSUE	Description	Chkd	Date
0				
1				
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PROJECT	TRACC TRANSITION TO FLEXBEAM ASSEMBLY
TITLE	GENERAL ARRANGEMENT

DATE	03/08/09	INGAL CIVIL PRODUCTS
DRAWN	MS	REFERENCE No.
DESIGNED/CP		
CHECKED T.C.		
MATERIALS SHOWN		
FINISH	AS SHOWN	
SCALE	N.T.S.	
DRAWING No.	CAB-STD-092	
REVO		



Rev	INITIAL	ISSUE	Description	MS	03/08/09	Chkd	Date
0							



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PROJECT	TITLE
SINGLE SIDED TRACC TRANSITION TO CONCRETE BARRIER	RIGHT SHOULDER TRAFFIC PLAN AND ELEVATION

DATE	DRAWN	CHECKED	MATERIALS SHOWN	FINISH	SCALE	DRAWING No.
03/08/09	MS	ICP	AS SHOWN	AS SHOWN	N.T.S	CAB-STD-07
						REV.0



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