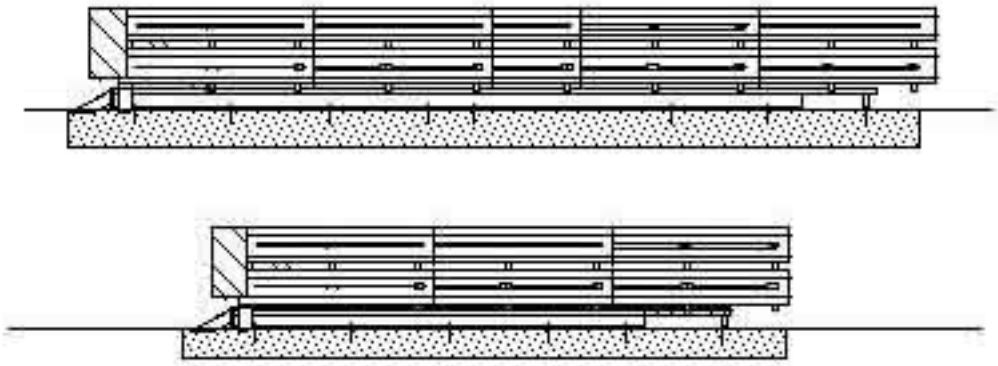
TRACC

Trinity Attenuating Crash Cushion

Design Manual



An NCHRP Report 350 Crash Cushion

CSP Pacific
Business Unit of Fletcher Concrete & Infrastructure Limited
306 Neilson Street
Onehunga, Auckland
Phone: (09) 634 1239 or 0800 655 200
Fax: (09) 634 4525

Table of Contents

Figures and Tables

CUSTOMER SERVICE

CSP Pacific is committed to the highest level of customer service. Comments regarding the quality and workmanship of our products, their installation procedures, supporting documentation, and roadside performance are welcome. Our goal is to enhance highway safety through continuous improvement and innovation. More information can be obtained by contacting CSP Pacific at:

Head Office Contacts:

Telephone: (09) 634 1239

Fax: (09) 634 4525

E-mail: info@csppacific.co.nz

Internet: www.csppacific.co.nz

TRACC DESIGN

General Information

Product Overview

The TRACC (Trinity Attenuating Crash Cushion) is a fully-redirective, non-gating, bi-directional, energy absorbing crash cushion designed to protect motorists from impacting the end of concrete barriers and bridge parapet rail, bridge piers and other hazards in both permanent and temporary work zone locations. The product has been accepted by the U.S. Federal Highway Administration for use on the National Highway System regardless of design or posted speed.

The TRACC System is available in various sizes. The compact Test Level 2 SHORTRACC is an economical solution for applications where the speed is 45 mph (70 kph) or lower. The standard Test Level 3 TRACC is acceptable for all speeds above 45 mph (70 kph). The FASTRACC is a Test Level 3 crash cushion that provides additional capacity for high-speed impacts. The WIDETRACC can be designed to shield hazards of any width.

Maintenance Overview

The TRACC System is a very low maintenance roadside safety feature. Except for repairs due to impact, there is virtually no maintenance required for the system. It is recommended that an annual drive-by inspection be performed to ensure that no minor impacts went undetected and that debris has not accumulated around the system.

Crash Performance

The standard TRACC meets National Cooperative Highway Research Program (NCHRP) Report 350 - Test Level 3 requirements. The system will redirect vehicles that impact along its side at angles up to 20^{O} with the axis of the system. It will also stop vehicles that impact the end of the system at angles up to 15^{O}. All testing was performed at speeds of 62 mph to 70 mph (100 kph to 113 kph) making the TRACC an appropriate choice for **ALL** design speeds or posted speed limits on the National Highway System.

The compact SHORTRACC is accepted by the U. S. Federal Highway Administration as a Test Level 2 (70 km/hr) system and can be used where speeds are 45 mph (70 kph) or less.

A copy of NCHRP Report 350 can be obtained at the following address:
Transportation Research Board
National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418
http://www4.nationalacademies.org/trb/crp.nsf/All+Projects/NCHRP+22-07

Low-Risk Repair Philosophy

Field repair of crash cushions is a dangerous activity that puts workers and motorists at risk. For this reason, the TRACC has been designed to allow rapid replacement as a complete unit after most impacts. Once the system has been removed from the roadway, repair can be done conveniently and accurately in the safety of the maintenance yard. Many of the TRACC's components remain undamaged after most impacts making refurbishment simple and economical. **Although field repair is certainly possible with the TRACC**, shop repair is recommended for all but cosmetic damage.

NOTE: THE TRACC IS **NOT** A DISPOSABLE SYSTEM. COMPLETE REPLACEMENT ON THE ROADSIDE AFTER AN IMPACT PROTECTS WORKERS BY LIMITING EXPOSURE TO TRAFFIC. UP TO 98% OF THE TRACC IS REUSABLE AFTER DESIGN IMPACTS. REPAIRS SHOULD BE MADE IN THE SAFETY OF THE MAINTENANCE SHOP.

Location Requirements

Unidirectional Application

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. See Figures 1 and 2. The backup frame can be attached to any solid structure including a square cast-in-place concrete pillar, a vertical concrete wall, or the end of a New Jersey style barrier. The backup frame provides a hole pattern that may require adaptation to the backup structure. Trinity Industries can provide an adaptor to allow direct attachment of the backup frame to a variety of concrete barrier profiles. Call Technical Service at +1-330-545-4373 with questions regarding this and other types of installation.

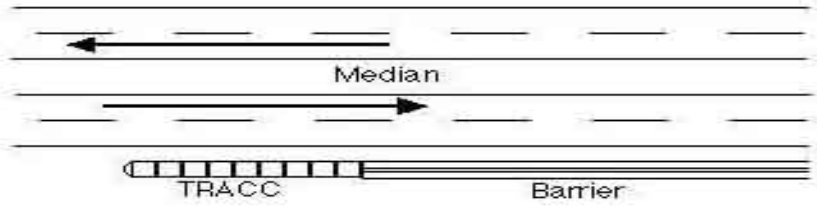


Figure 1. Unidirectional Traffic Flow - One Side - Requires No Transition.

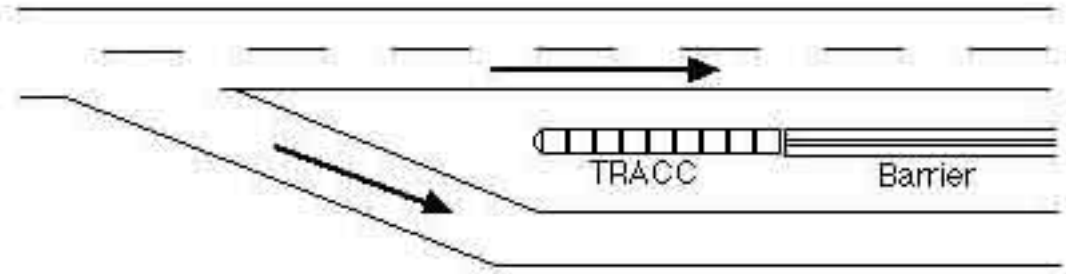


Figure 2. Unidirectional Traffic Flow - Both Sides - Requires No Transition.

Bidirectional Application

For installations that face oncoming traffic from the reverse direction (see figure 3), appropriate transitions should be installed on the end of the backup structure.

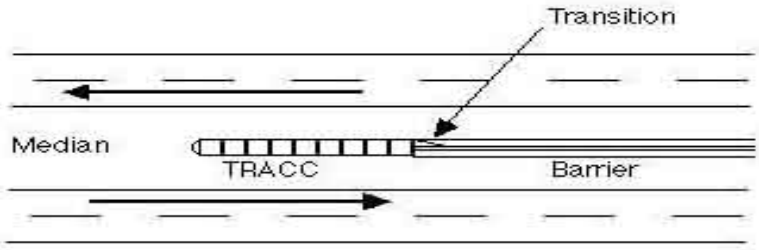


Figure 3. Bidirectional Traffic Flow - Requires Transition on One Side.

Approach Zone and Clear Zone

The TRACC System should not be placed directly behind a raised curb. 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 clear zone behind the TRACC should be consistent with the area behind the downstream Length-of-Need of the barrier. The entire length of the TRACC can be used in Length-of-Need calculations as it is fully redirecting.

Downstream Zone

The TRACC or SHORTRACC should be installed so that a 60" (1.5m) clear space will exist on both sides of the backup structure for the side panels to retract during an end-on impact (see figure 4).

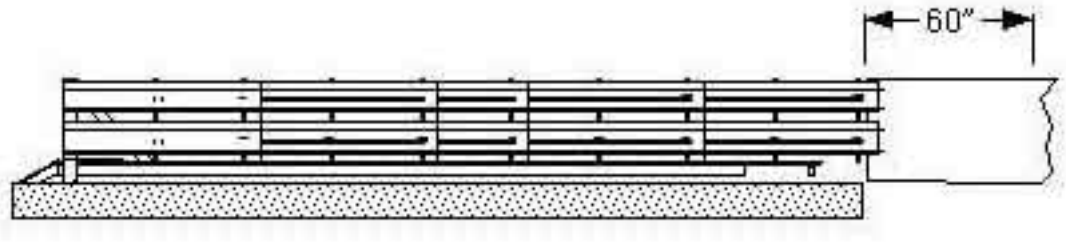


Figure 4. Clear Space for Panel Retraction

Foundation Options

During an impact, the stopping force provided by a TRACC System 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.

Concrete Anchorage Option

The TRACC System can be anchored to concrete foundations like those shown in Appendix drawings SS457, SS458, and SS459, depending on the type of backup or transition required. Drawing SS457 and 458 show foundation plans that can be used when attaching the TRACC System directly to downstream barriers. Drawing SS459 shows a foundation plan that includes a concrete backup.

Asphalt Anchorage Option

The TRACC can be anchored to combinations of asphalt, concrete, and compacted sub-base as shown in Table 1 below.

Table 1. Foundation Options

6” (150mm) Reinforced Concrete

8” (200mm) Unreinforced Concrete

3” (75mm) Minimum Asphalt over 3” (75mm) Minimum Concrete

6” (150mm) Asphalt over 6” (150mm) Compact Subbase

8” (200mm) Minimum Asphalt

Backup Support Options

Square Backup Option

The last frame of a TRACC System can be attached to a square concrete backup. Please refer to the following drawing located in the Appendix or online at www.highwayguardrail.com, for details:

SS456, TRACC Transition to Vertical Wall

Concrete Barrier Backup Option

The last frame of a TRACC System can be attached directly to a concrete barrier. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for details:

SS461, TRACC Transition to Concrete Safety Shape Barrier Plan, Elevation & Sections
SS462, TRACC Transition to Concrete Barrier Single Slope Plan, Elevation & Sections

Guardrail Backup Option (Base-Plated Post)

The last frame of a TRACC System can be attached to a base plate post located at the end of a section of guardrail. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for details:

SS455, TRACC Transition to W-beam Median Barrier Plan, Elevation & Sections
SS463, TRACC Transition to Thrie Beam Median Barrier Plan, Elevation & Sections
SS464, TRACC Transition to Thrie Beam Median Barrier All Wood Post
SS458, Crash-Cushion Attenuating Terminal 23 Foundation Plan

Guardrail Backup Option (Driven Post)

The last frame of a TRACC System can be attached to a soil mounted post located at the end of a section of guardrail. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for details:

SS453, TRACC Transition to W-beam Median Barrier Soil Post Option
SS454, TRACC Transition to Thrie Beam Median Barrier, Soil Post Option
SS457, Crash-Cushion Attenuating Terminal 22 Foundation Plan

Transition Options

For bi-directional installations requiring transitions, Trinity Industries offers a variety of standard hardware components. Transitions to concrete barrier, concrete backups, and various types of guardrail are discussed in the sections that follow and can be examined in the drawings located in the Appendix to this document.

Vertical Wall Transition

When the last frame of a TRACC System is attached to a vertical wall in a location that allows a reverse-direction impact, a transition will be required. Please refer to the following drawing located in the Appendix or online at www.highwayguardrail.com, for more details:

SS456, TRACC Transition to Vertical Wall

If the vertical wall to which the TRACC System is transitioned is followed by a concrete safety shape barrier, it may be desirable to transition the barrier as shown in Figure 5. Local standards should be consulted for taper rates and other design parameters.

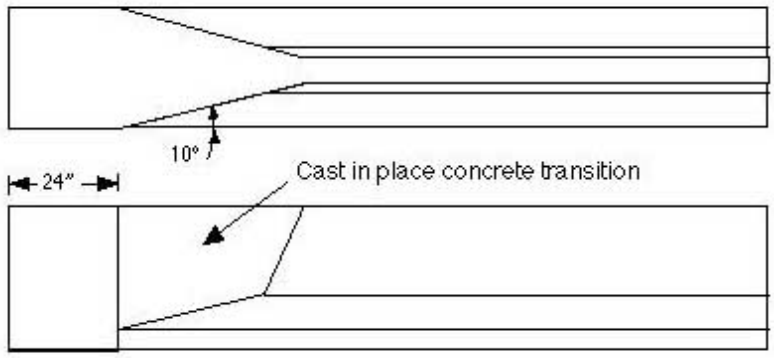


Figure 5. Transition of Concrete Barrier to Vertical Wall.

Concrete Barrier Transition

When the last frame of a TRACC System is attached directly to a concrete barrier in a location that allows a reverse-direction impact, a transition will be required. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for details:

SS461, TRACC Transition to Concrete Safety Shape Barrier Plan, Elevation & Section
SS462, TRACC Transition to Concrete Barrier Single Slope Plan, Elevation & Sections

Guardrail Transition (Thrie Beam)

When a TRACC System is attached to a thrie beam guardrail barrier in a location that allows a reverse-direction impact, a transition will be required. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for details:

SS463, TRACC Transition to Thrie Beam Median Barrier Plan, Elevation & Sections
SS464, TRACC Transition to Thrie Beam Median Barrier All Wood Post
SS454, TRACC Transition to Thrie Beam Median Barrier, Soil Post Option

Guardrail Transition (W-Beam)

When a TRACC System is attached to a W-beam guardrail barrier in a location that allows a reverse-direction impact, a transition will be required. Please refer to the following drawings located in the Appendix or online at www.highwayguardrail.com, for details:

SS455, TRACC Transition to W-beam Median Barrier - Plan, Elevation & Sections
SS453, TRACC Transition to W-Beam Median Barrier, Soil Post Option

Nose Delineation Options

The TRACC and SHORTRACC are intended for use on either shoulder or in the median in both unidirectional and bi-directional traffic situations. To provide the greatest level of safety, the delineation of the plastic nose section can be customized for any particular location. Four pieces of reflective tape are provided with the TRACC and can be used to delineate left shoulder, right shoulder, and gore applications. All four identical pieces of reflective tape can be used to create the three designs as shown in Figure 6.

Gore Area Right Shoulder Left Shoulder

Figure 6. Nose Delineation Options.

Note: Consult local transportation authorities for delineation requirements.

APPENDIX

SS450, Crash-Cushion Attenuating Terminal - TL-3 Plan, Elevation & Sections
SS451, Crash-Cushion Attenuating Terminal Plan, Elevation & Sections, Shop Assembly Details
SS452, TRACC Anchoring Options
SS453, TRACC Transition to W-Beam Median Barrier Soil Post Option
SS454, TRACC Transition to Thrie Beam Median Barrier Soil Post Option
SS455, TRACC Transition to W-beam Median Barrier Plan, Elevation & Sections
SS456, TRACC Transition to Vertical Wall
SS457, Crash-Cushion Attenuating Terminal 22' (6700mm) Foundation Plan
SS458, Crash-Cushion Attenuating Terminal 23' (7000mm) Foundation Plan
SS459, Crash-Cushion Attenuating Terminal 24' (7315mm) Foundation Plan
SS461, TRACC Transition to Concrete Safety Shape Barrier Plan, Elevation & Sections
SS462, TRACC Transition to Concrete Barrier Single Slope Plan, Elevation & Sections
SS463, TRACC Transition to Thrie Beam Median Barrier - Plan, Elevation & Sections
SS464, TRACC Transition to Thrie Beam Median Barrier All Wood Post
SS466, TRACC - TL-2 Plans, Elevation & Sections
SS467, TRACC - TL-2 Shop Assembly Details
SS468, TRACC - TL-2 Foundation Plans

Any of above mentioned drawings will be sent upon request