Important: These instructions are to be used only in conjunction with the assembly, maintenance, and repair of the CASS™ system. These instructions are for standard assembly 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. This system has been determined to meet the criteria for eligibility for reimbursement by the Federal Highway Administration for use on the national highway system under strict criteria utilized by that agency. A Trinity Highway Products, LLC representative is available for consultation if required.

This Manual must be available to the worker overseeing and/or assembling the product at all times. For additional copies, contact Trinity Highway Products, LLC at (888) 323-6374 or download from website below.

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 CASS™ system information available to Trinity Highway Products at the time of printing. We reserve the right to make changes at any time. Please contact Trinity Highway Products to confirm that you are referring to the most current instructions.
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Customer Service Contacts

Trinity Highway Products, LLC is committed to the highest level of customer service. Feedback regarding the CASS™ system, its assembly procedures, supporting documentation, and performance is always welcome. Additional information can be obtained from the contact information below:

Trinity Highway Products, LLC:

<table>
<thead>
<tr>
<th>Telephone:</th>
<th>(888) 323-6374 (USA Only)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+1 (214) 589-8140 (International Calls)</td>
</tr>
<tr>
<td>Fax:</td>
<td>(214) 589-8423</td>
</tr>
<tr>
<td>E-mail:</td>
<td><a href="mailto:product.info@trin.net">product.info@trin.net</a></td>
</tr>
<tr>
<td>Internet: Trinity Highway Products, LLC</td>
<td><a href="http://www.highwayguardrail.com">http://www.highwayguardrail.com</a></td>
</tr>
<tr>
<td></td>
<td>Trinity Industries, Inc.</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.trin.net">http://www.trin.net</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Centerville, Utah</th>
<th>(800) 772-7976</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dallas, Texas</td>
<td>(800) 527-6050</td>
</tr>
<tr>
<td>Elizabethtown, Kentucky</td>
<td>(800) 282-7668</td>
</tr>
<tr>
<td>Girard, Ohio</td>
<td>(800) 321-2755</td>
</tr>
<tr>
<td>Orangeburg, South Carolina</td>
<td>(800) 835-9307</td>
</tr>
<tr>
<td>Canada</td>
<td>(800) 835-6051</td>
</tr>
</tbody>
</table>

Important Introductory Notes

Proper assembly of the CASS™ system is essential to achieve performance of the system under appropriate federal and state criteria. These instructions should be read in their entirety and understood before assembling the CASS™ system. These instructions are to be used only in conjunction with the assembly of the CASS™ system and are for standard assemblies only as specified by the applicable highway authority. In the event your system assembly requires or involves deviation from standard parameters or, during the assembly process a question arises, please contact the appropriate highway authority that specified this system at this particular location for guidance. Trinity Highway Products, LLC is available for consultation with that agency. These instructions are intended for an individual who is qualified to both read and accurately interpret them as written. They are intended for the individual who is experienced and skilled in the assembly of highway products which are specified and selected by the highway authority.

A set of product and project shop drawings will be supplied by Trinity Highway Products, LLC. The shop drawings will be for each section of the assembly. These drawings should be reviewed and studied thoroughly by a qualified individual who is skilled in interpreting them before the start of any assembly.
**Important:** Read safety instructions thoroughly and follow the assembly directions and suggested safe practices before assembling, maintaining, or repairing the CASS™ system. Failure to follow this warning can result in serious injury or death to workers and/or bystanders. It further compromises the acceptance of this system by the FHWA. Please keep these instructions for later use.

**Warning:** Ensure that all of the CASS™ system Warnings, Cautions, and Important Statements within the CASS™ system Manual are completely followed. Failure to follow this warning could result in serious injury or death in the event of a collision.

**Recommended Safety Rules for Assembly**

* Important Safety Instructions *

This Manual must be kept in a location where it is readily available to persons who are skilled and experienced in the assembly, maintenance, or repair of the CASS™ system. Additional copies of this Manual are immediately available from Trinity Highway Products, LLC by calling (800) 879-8000 or by email at product.info@trin.net. This Manual may also be downloaded directly from the websites indicated below. Please contact Trinity Highway Products, LLC if you have any questions concerning the information in this Manual or about the CASS™ system.

Always use appropriate safety precautions when operating power equipment and when moving heavy equipment or the CASS™ system components. Gloves, safety goggles, steel toe boots, and back protection should be used.

Safety measures incorporating traffic control devices specified by the highway authority must be used to provide safety for personnel while at the assembly, maintenance, or repair site.
Safety Symbols
This section describes the safety symbols that appear in this CASS™ system Manual. Read the Manual for complete safety, assembly, operating, maintenance, repair, and service information.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Safety Alert Symbol]</td>
<td><strong>Safety Alert Symbol</strong>: Indicates Danger, Warning, Important, or Caution. Failure to read and follow Danger, Warning, Safety, or Important Statement indicators could result in serious injury or death to workers and/or bystanders.</td>
</tr>
</tbody>
</table>

Warnings and Cautions
Read all instructions before assembling, maintaining, or repairing the CASS™ system.

**Warning**: Do not assemble, maintain, or repair the CASS™ system until you have read this Manual thoroughly and completely understand it. Ensure that all Warnings, Cautions, and Important Statements within the Manual are completely followed. Please call Trinity Highway Products at (800) 879-8000 if you do not understand these instructions. Failure to follow this warning could result in serious injury or death.

**Warning**: Safety measures incorporating appropriate traffic control devices specified by the highway authority must be used to protect all personnel while at the assembly, maintenance, or repair site. Do not stand adjacent to this system when there is any risk that the cable may be impacted and/or severed when under tension. Failure to follow this warning could result in serious injury or death.

**Warning**: Use only Trinity Highway Products, LLC parts that are specified herein for the CASS™ system for assembling, maintaining, or repairing the CASS™ system. Do not utilize or otherwise comingle parts from other systems even if those systems are other Trinity Highway Products systems. Such configurations have not been tested, nor have they been accepted 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 an UNACCEPTED system.

**Warning**: Do NOT modify the CASS™ system in any way. Failure to follow this warning could result in serious injury or death.

**Warning**: Ensure that the CASS™ system and delineation used meet all federal, state, specifying agency, and local specifications. Failure to follow this warning could result in serious injury or death.

**Warning**: Ensure that your assembly meets all appropriate Manual on Uniform Traffic Control Devices (MUTCD) and local standards. Failure to follow this warning could result in serious injury or death.

**Warning**: Be aware of hazards of using compressed air (small objects may become projectiles). Failure to follow this warning can result in serious injury or death to the workers and/or bystanders.
Important Introductory Notes About This System

These instructions are to be used only in conjunction with the assembly of the CASS™ system for a NCHRP-350 Report TL-3 or TL-4 assembly.

Proper deployment and maintenance of the CASS™ system is critical to achieve performance under appropriate state and federal guidelines. Take the time to review this Manual, including the Limitations and Warnings section, thoroughly before performing the necessary work. Do not attempt to assemble any CASS™ system without the proper plans and assembly Manual from the manufacturer.

In the event your system assembly requires or involves special circumstances or, if during the assembly process, a question arises regarding a particular assembly step, contact a Trinity Highway Products, LLC representative before proceeding.

If you require additional information, or have questions about the CASS™ system, please contact Trinity Highway Products, LLC Customer Service Department (See Page 3).

Important Notice

These instructions are to be used only in conjunction with the instructional manual of the CASS™-TL3 or CASS™-TL4 systems. These instructions are for standard maintenance and/or repairs only as specified by the applicable state or specifying agency.

In the event your system maintenance and/or repairs require or involve special circumstances or a question arises regarding a particular step, contact a Trinity Highway Products representative before proceeding (See Page 3).

Introduction

These instructions should be read in their entirety and understood before performing any maintenance and/or repairs on the CASS™, CASS™-TL3, or CASS™-TL4 systems.

For these instructions, the CASS™, CASS™-TL3 and CASS™-TL4 systems will be referred to as the CASS™ system unless denoted by CASS™-TL3 or CASS™-TL4 systems.
General CASS™ Information

Pre-Stretched Cable
For pre-stretched cable, the cable tension should be checked at least once a year. The tension value is established based on either the ambient air temperature or the cable temperature, which can be taken using a thermometer for the air temperature or an infrared thermometer for the cable temperature. See the CASS™ System Temperature and Tension Chart(s) for the tension values (See Pages 32 & 33).

Standard Cable
For standard cable, the cable tension should be checked at least twice a year. The tension value is established based on either the ambient air temperature or the cable temperature, which can be taken using a thermometer for the air temperature or an infrared thermometer for the cable temperature. See the CASS™ System Temperature and Tension Chart for the tension values (See Pages 32 & 33).

Important: Read safety instructions thoroughly and follow the suggested safe practices before assembling, maintaining, and repairing the CASS™ system. Failure to follow this warning can result in serious injury or death to the worker and/or bystanders. Please keep these instructions for later use.

Warning: Ensure that all of the CASS™ system Warnings, Cautions, and Important statements within the CASS™ system Manual are completely followed. Failure to follow this warning could result in serious injury or death in the event of a collision.

Warning: If it is necessary to totally remove the fitting ends from the turnbuckle, the tension must first be released on the assembly by means of a come-along, backhoe, or other mechanical means. Failure to follow this warning can result in serious injury or death to the worker and/or bystanders.
**Safety Instructions**

Always use appropriate safety precautions when operating power equipment and mixing chemicals, and when moving heavy equipment or the CASS™ system components. Gloves, safety goggles, and back protection should be used.

Safety measures incorporating traffic control devices must be used to provide safety for personnel while at the assembly/maintenance/repairs site.

**Ground Preparation and Barrier Alignment**

The CASS™ system shall be deployed on shoulders or medians with slopes of 6:1 or flatter without obstructions, depressions, etc. that may significantly affect the stability of an errant vehicle. Grading of the site and/or appropriate fill materials may be required. The technician shall “flatten” or “round” various topographical inconsistencies that could interfere with the ability of workers to consistently maintain the design height (in relation to the terrain) of the cables.

When the cable is placed on a ditch section and a vehicle can strike it after crossing the ditch, the appropriate highway authority or agency’s policy should be followed when the slopes are steeper than 10:1 and the cable is in an area of 1 to 8 feet from the ditch bottom. Per Federal Highway Administration (FHWA) and American Association of State Highway and Transportation Officials (AASHTO), a cable should not be placed from 1 to 8 feet from the ditch line.

The CASS™ system can be placed in front of slopes 2:1 or flatter. The distance from the hinge point to the center of the post should be 2 feet, with 1 foot minimum.

When a curb is used with the CASS™ system, the height of the curb should not be higher than 4 inches (100 mm) and on high-speed roadways, the CASS™ system should not be placed behind the curb in an area from 1.5 to 8 feet. When the CASS™ system needs to be deployed on roadways with a speed of 40 mph or less, and a curb is present, contact the appropriate highway authority representative before proceeding. Trinity Highway Products is available to consult with that highway authority or agency.

If the barrier must be flared, the flare rate is 30:1 or flatter.

The appropriate highway authority or agency’s standards for grading and widening for guardrail terminals should be used for the CASS™ Cable Terminal.

**Layout Aligning the CASS™ System**

Follow all procedures in the placement of the footing and/or post to insure proper alignment. To achieve this, it is suggested that a string line or other means be used to provide a consistent horizontal and vertical alignment that meets specifications.

**Post and Post Foundation Assembly**

**Post**

The CASS™ system posts can be driven, placed in a driven sleeve, enclosed in a sleeve in a concrete footing (poured or pre-cast), or mounted to a concrete surface. Driven CASS™-TL3 system posts are 72” long and driven CASS™-TL4 system posts are 81” long. For posts placed in a sleeve, the CASS™-TL3 system posts are 47 1/4” long and the CASS™-TL4 system posts are 55 1/4” long. For posts mounted to a concrete surface, the CASS™-TL3 system post is 31 5/8” long and the CASS™-TL4 system post is 39 5/8” long. These lengths are for the concrete surface flush with the ground.
Post Foundations (Line Post)

For post spacing of 20’ or less, the driven sleeves are 31 inches in length and the sleeves placed in a concrete footing are 27 inches long. For post spacing of 20’ or more, the driven sleeves are 42 inches in length and the sleeves enclosed in a concrete footing are 27 inches long (See Figure 1).

1. If the post spacing is 20’ or less, the concrete footings are 12” in diameter and 30” deep.
2. If the post spacing is 21’ to 30’, the concrete footings are 12” in diameter and 42” deep.
3. The concrete strength must be 3000-psi or greater if necessary to meet the agency’s specifications.
4. The concrete footing can be poured in augured or punched holes or pre-cast and placed in augured or punched holes.
5. The 27-inch sleeve is utilized.
6. A plastic cap is placed on the bottom end of the sleeve to prevent the concrete from coming up from the bottom.
7. A #3 rebar ring is placed around the top of the sleeve 2 to 3 inches from the top of the footing.
8. Insert sleeve and center in concrete after it is poured.

**Note:** A vibrator is helpful to get the sleeve into the concrete. The sleeves must be plumb. Use a string line and level to keep the sleeves on alignment.

9. It is recommended that a plastic cover can be placed on the post to keep debris out of the sleeve (See Figure 2).

---

**Figure 1**

**Sleeve For Concrete Footing**  
**Driven Sleeve**  
**Driven Sleeve with Soil Plate**

---

**Figure 2 Plastic Cover for Post**

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10. The base plated post must be placed on a concrete surface of 6 inches or more in depth.
11. Secure to the 8” x 8” x 5/8” steel plate to the concrete surface with four (4) 5/8” diameter x 8” long, all threaded chisel point, A-449 rods with an appropriate anchoring adhesive. (A 5/8” mechanical anchor with a pull out strength of 10,000 lbs. can also be used.)
12. Place a 5/8” flat washer and lock washer (F 436) between the 5/8” hex nut (A565 DH) and the plate (See Figure 3).

![Figure 3 Base Plated Post]

**Post Spacing on a Curve**

Complete the following steps to assemble the posts and/or post foundations along a curve:

1. When the cable is assembled on a curve, post spacing may need to be reduced based on the radius.

**Note:** The post spacing criteria for a curve will be the same for both pre-stretched and standard cable.

2. Weak soil conditions may necessitate a larger footing for the line posts, based on the radius of the curve.

**Note:** It is imperative, before assembly, that you contact a THP representative and highway authority engineer for special criteria involving weak soil conditions. It is also recommended that you consult your own soils or structural engineer.

3. When assembling posts on a curve, use the table below to adjust the spacing as needed:

<table>
<thead>
<tr>
<th>Curve Radius</th>
<th>Post Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 650’</td>
<td>Contact a Trinity Highway Products Representative and appropriate highway authority representative</td>
</tr>
<tr>
<td>650’ to 1300’</td>
<td>10’ post spacing or less (as specified by state specifying agency)</td>
</tr>
<tr>
<td>1301’ to 2250’</td>
<td>16.5’ post spacing or less (as specified by state specifying agency)</td>
</tr>
<tr>
<td>Greater than 2250’</td>
<td>Project post spacing or less (as specified by state specifying agency)</td>
</tr>
</tbody>
</table>

**Note:** If any of the post spacing for a particular radii grouping is larger than the project post spacing, the project post spacing should be used.
Post Sleeve/Post Assembly when Encountering Rock

If rock is encountered when placing the post sleeve or the post, use the following procedures, unless there is a more restrictive state specification.

Post Sleeve

If rock is encountered within 9 inches of embedment depth of Post Sleeve, drill a 12-16 inch diameter hole in the rock. The hole should be drilled 3 inches deeper than the required embedment depth. The hole is filled with 3000-psi concrete. The sleeve should be positioned as would be for the concrete footing including the rebar ring.

If a rock is encountered and more than 9-inch depth into the rock is required to position the full sleeve, drill a 12-16 inch diameter hole 12 inches deep into the rock. The minimum depth to the bottom of the hole from the ground line shall be 18 inches. Cut off the embedded portion of the sleeve so the top will be just above the top of the ground line (concrete footing).

Note: There must be three inches of concrete below the sleeve. Fill the hole with 3000-psi concrete. The sleeve should be assembled the same as would be for the concrete footing including the rebar ring.

Driven Posts

If rock is encountered and 13 inches or less depth is required to complete the placement of the full post, drill a 6-8 inch diameter hole to the required depth in the rock. Backfill and compact the hole after positioning the post. If compactable, the material removed from the hole may be used for the backfill.

If a rock is encountered and more than 18-inch depth is required to place the full post, drill a 6-8 inch diameter hole 18 inches deep into the rock. Cut off the embedded portion of the post so the cable will be placed at the proper mounting height. Backfill and compact the hole after placing the post. If compactable, the material removed from the hole may be used for the backfill.

CRP Stub Posts 1-3

If rock is encountered and 30 inches or less depth is required to complete the placement of the full hole, drill an 18-inch diameter hole to the required depth in the rock. Position the required rebar and CRP stub post and fill the hole with 3000-psi concrete. See the CASS™ Cable Terminal (CCT) section for rebar requirements.

If rock is encountered and more than 30-inch depth is required to emplace the full rebar, drill an 18-inch diameter hole 30 inches deep into the rock. (The minimum depth to the bottom of the hole from the ground line needs to be 33 inches). Cut off the embedded portion of the rebar so the top of rebar will be 3 inches below the ground line (concrete footing).

Note: There must be 3 inches of concrete below the rebar(s). Place the rebar(s) and the CRP stub post and fill the hole with 3000-psi concrete. See the CASS™ Cable Terminal (CCT) section for rebar requirements.
Cable Barrier End Treatments

The CASS™ system barrier is terminated with one of the following methods:

1. CASS™ Cable Terminal (CCT)
2. CASS™ Cable Anchor (CCA)
3. CASS™ Transition to W-Beam (CTW)
4. CASS™ Transition to Thrie Beam (CTT)
5. CASS™ Transition to Box Beam (CTB)
6. Transition to Colorado 3F
7. CASS™ Bracket (CB)

CASS™ Cable Terminal (CCT)

The CASS™ Cable Terminal (CCT) consists of three (3) Cable Release Posts (CRP) and six (6) S3x5.7 posts. The posts are 5’3” long for the CASS™-TL3 system and 5’3” to 5’11” long for the CASS™-TL4 system (See the Drawing Section post locations). The cables are terminated at the CRP posts, one at each post. The CRP is a two-part post system (stub post and upper post). The stub post (W6 x 15) is 2 foot in length. The upper post (W6 x 8.5) is 32” in length. The post stub should be placed in a 1′-6” diameter x 5 foot deep reinforced concrete footing. The concrete strength shall be 3000-psi or greater if necessary to meet an agency’s specifications. The footing is reinforced with a spiral rebar cage. The spiral is made of #3 rebar, 4’6” long, with a 6” pitch and 1 turn flat on each end. Eight #6 x 4’6” long rebar is equally spaced and wire tied to the inside of the spiral cage. An alternate to the spiral cage is a rebar cage made of #3 rebar rings spaced at 6 inch on center and tied together with eight (8) #6 x 4’6” rebar.

The top of the concrete footing should be at ground line and the top of the stub shall not be more than 4 inches above the ground line. The stub post should be secured so that it retains its height and alignment during the concrete pour. The upper post is attached to the stub post with two (2) 5/16” x 2” bolts, 5/16” nut and 5/16” washer assemblies (See Figure 4).

For soil plate placement, the 5’0” bottom post with a 2’0” x 4’0” soil plate can be driven or positioned in an augured hole. The hole should be augured about 4 feet or less deep and the post driven the rest of the way in. The soil plate can be either welded or bolted to the bottom CRP (See Figure 4). The upper post should be assembled as described above.

The top of the bottom post for either assembly shall not be more than 4 inches above the ground line.
The post spacing between posts 1 through 4 is 6'-3". Posts 1, 2, and 3 are offset from the cable centerline. The offsets are measured to the center of the CRP’s. Posts 1 and 3 will be offset to the same side with post 2 being offset to the opposite side.

**Note:** Posts 1 and 3 will be located on the traffic side or side nearest to the traffic. If the CASS™ system is positioned on the centerline of the median, Posts 1 and 3 should be placed on the side of the approaching traffic end of the assembly. See **Figure 5** for the CRP layout.

**Figure 5 CRP Layout**

Posts 4 through 9 are enclosed in a sleeve with Option A, concrete footing or Option B, a soil plate.
Option A
Preventing concrete from seeping into the bottom of the 30 3/4” tube sleeve is important. Duct tape has proven to be a readily available material for preventing concrete seepage within the tube sleeve. It is recommended that at least 3 layers of duct tape be applied to the base of the sleeve with 1 inch of overlap per piece to ensure a seal. Whatever tape is used, it should be such that moisture and chemicals found in concrete mixtures cannot seep within the sleeve. Contact your THP representative with any questions (See Page 3). The concrete footing is 12 inches in diameter and 3 feet deep. A #3 rebar ring is placed around the top of the sleeve, 3 inches from the top of the footing. Two (2) #4 rebar x 2’-8” are placed vertically approaching traffic.

Option B
Two soil plate options are to attach a soil plate to the post or attach a soil plate to the sleeve for the post. These posts should be driven. If the holes are augered, the material should be compacted after assembly. At post 4, two (2) bearing angles are secured to the post at the ground line (See Figure 6).

![Diagram of Option B](image)

**Figure 6 Bearing Angles for Post**
The CCT cables are connected to the CRP’s by inserting the right hand fitting (red end) through hole created by the bottom and top CRP. The longest cable is attached to the first CRP. The shortest cable is attached to the third CRP. The CRP Cable Bracket is then attached to the fitting (See Figure 4). Two (2) 1” hex nuts (A194) and a 1” flat washer (F436) are placed on the end of the fitting. Leave about 2 inches of thread between the end of the fitting and the nuts.

The CCT cables are attached with the top and bottom cable on one side of the post and the middle cable on the other side. The top and bottom cables should be affixed to the six (6) S3x5.7 posts on the side nearest to the traffic.
**Cable height when used with CASS™-TL3 system:** The top and bottom cables are positioned at 21 and 29.5 inches above the ground. The middle cable is placed at 25 inches above the ground at post 9. The cable is then tapered down between posts 9 and 7 to the height of the bottom cable. The cable is then run parallel to the bottom cable to post 4.

**Cable height when used with CASS™-TL4 system:** At post location 9, the top, middle, and bottom cables are positioned at 38, 29.5, and 21 inches above the ground. The top cable is then tapered down between post 9 and 7 to the height of 29.5 inches. This cable remains at 29.5 inches from post 7 to post 4. The middle cable is tapered down between posts 9 to 7 to the height of the bottom cable. The middle and bottom cable height from post 7 to post 4 is 21 inches.

The cables are attached to the posts by a special patented hook bolt. For the assembly of the hook bolt, see Figure 7.

![Figure 7 Attachment of the Hook Bolt](image)

The hook bolts are attached with two (2) to three (3) threads beyond the nut so the cables can move through them during tensioning. No further tightening is required.
CASS™ Cable Anchor (CCA)

The CASS™ Cable Anchor (CCA) consists of an anchor block, a bracket to secure the cable to the anchor, two (2) CASS™ system posts, and three (3) 25 foot lengths of cable.

The anchor block is made of 3000-psi concrete or greater if necessary to meet an agency’s specifications and can either be pre-cast or cast in place. It is 10 feet [3 m] long, 5 feet [1.5 m] wide, and 5 feet [1.5 m] deep (See Figure 8). State standards or soil conditions may require a larger footing.

Eight (8) 3/4” hook bolts for the anchor bracket are placed in the footing before the concrete is poured. See Figure 8 for the location and spacing. As an option, anchor bolts can also be attached to the footing by drilling eight (8) 1” diameter x 12” deep holes. The 3/4” anchor studs can be assembled with an approved anchoring adhesive.

![Diagram of CASS™ Cable Anchor (CCA)](image)

**Figure 8 CCA**

Once the concrete has reached 3000-psi with the anchor bolts (A307) attached, the anchor bracket is secured to the footing with 3/4”flat washers (F844) and 3/4” hex nuts (A563).

The first CASS™ system post is placed 10 feet from the anchor bracket. The post can be in a concrete footing with a sleeve, a sleeve with or without a soil plate, or driven per the contract plans. When it is positioned with a sleeve without a concrete footing, or is driven, the bearing brackets (See CASS™ Cable Terminal (CCT)) must be attached to the post at the ground line. The second CASS™ system post is placed 10 feet on center from the first CASS™ system post.

The CCA cable ends are secured to the bracket with a 1” flat washer (F436) and two (2) 1” hex nuts (A194 2H).

The cable spacers at the first CASS™ system post needs to be either metal pipe spacers, 1 inch thick rubber spacers, or approved equal.
CASS™ Transition to W-Beam (CTW) or Thrie-Beam (CTT)

The CASS™ Transition to W-Beam (CTW) or CASS™ Transition to Thrie-Beam (CTT) connects the cable barrier directly to a W-beam or thrie-beam rail panel(s). The system requires reduced cable post spacing, slotted 10 gauge W-beam or thrie-beam rail panel(s) or nested 12-gauge W-beam or thrie-beam rail panel(s), anchor brackets, and a flared guardrail terminal. The device has been accepted under the National Cooperative Highway Research Program (NCHRP) guidelines and has received a Federal Highway Administration (FHWA) letter of acceptance.

Complete the following steps to transition the cables to W-Beam (CTW) or Thrie-Beam (CTT):

1. Attach the W-Beam or Thrie-Beam rail system, including the terminal. See the Drawing Section for guardrail layout.
2. Bolt the anchor brackets to the backside of the rail panel(s).
3. Assemble CASS™ system posts or footings and posts. See the Drawing Section for the post spacing.
4. After the posts are in position, place the appropriate cables through the slots in the rail panels and secure to the anchor brackets.
5. Secure the cables to the anchor brackets with (2) a 1” hex nuts (A194 2H) and a 1” washer (F436).
6. Attach the cable in the posts the same as the line cable is assembled, except the spacers for the first post are metal round spacers, or a 1” thick rubber spacer, or approved alternate (not the standard spacers).

CASS™ Transition to Box Beam (CTB)

The CASS™ Transition to Box Beam connects the cable barrier directly to a box beam section. The system requires reduced cable post spacing and a box beam section to anchor the cable to. The box beam section will have slots in it for the anchor brackets. The end of the box beam system is flared back so that a vehicle will not impact the end of the system.

CASS™ Transition to Colorado 3F

This assembly would be the same as for the Transition to W-beam.

CASS™ Bracket (CB)

The CASS™ Bracket provides a direct cable connection to a rigid barrier or wall. The CB is used on trailing end treatments and where a vehicle cannot impact the barrier from the back side. The CB is a bracket that is bolted to the back side of the barrier or wall and the cable connected to the bracket. The bracket is bolted to barrier with five (5) 7/8-inch high strength bolts and washers, and nuts with a beveled 1/4 inch plate on the traffic side.
**Cable Attachment**

Once the posts and terminals are attached, the cable can then be inserted into the posts. The line cable will either be factory cut to length or the lengths can be field cut from a reel of cable. The terminals and transition cables will normally be factory cut to a standard length.

**Pre-Stretched Cable**

**Standard Lengths**

The standard cable lengths are 1000 feet. These lengths can be either factory assembled with fittings or field cut from cable reels with lengths of 2000 to 4000 feet. Each of the cable assemblies will have a non-standard length to complete the cable run.

The factory assembled standard lengths will have a right-hand fitting (painted red) on one end and left-hand fitting on the other end. The first right-hand fitting to be removed from the reel will be painted red with a yellow dot. It is important that this end be removed first. If it isn’t, the cable will not come off the reel properly. During the unwinding process, someone should watch the reels to make sure none of the cable ends come loose. If they do, stop the unwinding and reattach the cable.

The cable on the reels will be in 1000 foot increments. The standard lengths will be field cut at 1000 foot increments, plus or minus 25 feet. A right or left-hand fitting will be field attached on each end.

**Non-Standard Lengths**

The non-standard lengths to complete the assembly can be factory assembled with a fitting or field cut from a reel of cable.

For the factory assembled lengths, there will only be a right-hand fitting (painted red) on one end. The other end will have a right-hand field fitting placed after it is cut to length.

For the length taken from a reel, a right-hand field fitting is attached. The cable will be removed from the reel and cut to length and a right-hand field fitting attached.

**Note:** For a cable run where the length is 1000 feet or less, the cable length will include the cable for the starting terminal/anchor. The right-hand fitting end will be attached per the terminal/anchor attachment instructions.

When the cable is cut from a reel, the last piece of cable removed from the reel can be field spliced to the end of the cable from a new reel to complete the cable length (See Figure 9).

**Standard Cable**

**Standard Length**

The standard cable lengths are 750 feet. These lengths can be either factory assembled with a fitting or cut from cable reels. The cable reel will usually be in lengths of 3000 feet. Each of the cable assemblies will have a non-standard length to complete the cable run. The factory cut assembled standard lengths will have a right-hand fitting (painted red) on one end. A left-hand field fitting will have to be field attached on the other end.

The first right-hand fitting to be removed from the reel will be painted red with a yellow dot. It is important that this end be removed first. If it isn’t, the cable will not come off the reel properly. During the unwinding process, someone should watch the reels to make sure none of the cable ends don’t come loose. If they do, stop the unwinding and reattach the cable.

The standard lengths cut from the reel will be field cut at 750 foot increments, plus or minus 25 feet. A right or left-hand fitting will be field attached on each end.
**Non-Standard**

The non-standard lengths to complete the assembly can be shop cut lengths or cut from a reel of cable.

For the factory assembled lengths, there will only be a right-hand fitting (painted red) on one end. The other end will have a right-hand field fitting attached after it is cut to length.

For the length taken from a reel, a right-hand field fitting is attached. The cable will be removed from the reel and cut to length and a right-hand field fitting attached.

**Note:** For a cable run where the length is 750 feet or less, the cable length will include the cable for the starting terminal/anchor. The right-hand fitting end will be attached per the terminal/anchor assembly instructions.

When the cable is cut from a reel, the last piece of cable removed from the reel can be field spliced to the end of the cable from a new reel to complete the cable length (See Figure 9).
The right-hand fitting end of the terminal/anchor or transition cable is placed at the anchor post and or anchor bracket and secured as per the Cable Barrier End Treatment instructions.

The first standard length end removed from the reel will be the end with the right-hand threaded fitting which is painted red with a yellow dot. The right-handed threaded end is connected to the left-handed threaded end of the terminal/anchor or transition cable. The cables are connected with a turnbuckle that has right and left threads (See Figure 10).

![Figure 10 Cable Splice with Turnbuckle](image)

Each threaded rod should be screwed in at least 1-1/2” into the turnbuckle (visible in the sight hole) to assure the continuity of the strength of the cable. The cables are unspooled and connected in this manner until the terminal/anchor or transition is reached at the other end of the run.

The cables are placed in the post slots, one cable at a time, with bottom cable first. Once the bottom cable is positioned, a plastic spacer is attached to each post (See Figure 11).

![Figure 11 1st Cable and Spacer Attached](image)
The middle cable is then placed in all of the posts. A plastic spacer and the stainless steel metal band are then assembled (See Figure 12).

![Figure 12 2nd Cable, Spacer, and Stainless Steel Strap Assembled](image)

The top cable is then attached (See Figure 13).

![Figure 13 3rd Cable Attached](image)

It is recommended before tensioning that for long runs of cable (greater than 5000 feet), the cable should be pulled at every 3000 foot intervals to get the slack out. A check should be made to see if any of the turnbuckles would interfere with the posts during the tensioning. If there are any, remove the post(s) or the cables from the post.

**Note:** For long runs of cable, the connection to the turnbuckle should be checked at every location to make sure that the cable has not unthreaded during the laying out or pulling out the slack process. The rod threads should be seen through the sight holes on each end of the turnbuckle.
Tensioning and Field Connection

Once all of the cables have been attached to the posts, the field connection and tensioning can take place.

The tension placed on the cables is to be determined by the air temperature or cable temperature at the time of tensioning. An accurate thermometer needs to be on site at the point of tensioning to obtain the correct air temperature. If there is a reason to believe that the cable temperature will have enough difference between it and the air temperature, the temperature of the cable should be obtained by infrared means and that temperature used. See the CASS™ System Temperature and Tension Chart for tension requirements.

Field Splice

Each CASS™ system assembly will require at least one field connection per cable to complete the deployment. There may be cases where the contractor may elect to complete all of the connections with field splices. The field splice must be correctly applied to ensure the connection will not separate.

Complete the following steps to make the field splice:

1. Make sure that the cable has a clean square cut by using a saw with an abrasive blade or an electric band saw.
2. Insert the cut end of the cable into the field casting through the triangular end.
3. With the cable inside the casting, the cable is separated with two flat head screw drivers so the tapered triangular wedge can be inserted.
4. The wedge is inserted into the cable with the smaller diameter end towards the triangular hole.

Note: All three strands of the cable are to be located in the appropriate grooves of the wedge

5. Make sure the wedge is pushed 1/2-inch beyond the end of the cable (plus or minus 1/8-inch).
6. Once the wedge is inserted, use a hammer to seat the wedge by hitting on the triangular end of the casting. Several hits should be made to seat the wedge.
7. After the wedge is properly seated, one wire of the cable must be bent over the end of the wedge.

1-inch Field Fitting

Place a 1-inch nut inside the casting and the 1-inch threaded rod is inserted through the hole of the casting and screwed into the nut. The 1-inch threaded rod must be screwed into the nut until all threads are utilized or the rod is against the end of the cable.

3/4-inch Field Fitting

A 3/4-inch nut is placed inside the casting and the 3/4-inch threaded rod is inserted through the hole of the casting and screwed into the nut. The 3/4-inch threaded rod must be screwed into the nut until all threads are utilized or the rod is against the wedge.

Note: Extreme care should be taken to ensure that the cable gripper is attached to the cable in such a location that if it slips, the chain or gripper will not hit the workers. This can be done by attaching the gripper near the end of the cable when marking it for cutting. After the cable has been cut, the gripper should be attached several posts away from where the connection is to be made. The equipment used for pulling the cable should be placed opposite the connection location or downstream from it. Equipment should be parallel to and as close as possible to the cable.
8. Once the fittings are attached, the cable is pulled again and connected to the terminal or transition end using a turnbuckle.

9. Based on the Temperature/Tension Chart, tension is then placed on the cables by turning the turnbuckles as necessary. See the Tensioning Meter Section for measuring the tension.

**Note:** The middle cable and then the top cable are tensioned using the same procedure.

A record of the tensioning should be recorded on the Tensioning Log Form found at the back of these assembly instructions.

If there were any removed post(s) or cables due to the turnbuckles interfering with post(s), the removed post(s) and cables should be reattached and the cable tension should be checked at intermittent locations along the run to make sure that the cable is properly tensioned. If the cable needs to be adjusted, it can be done at the intermittent turnbuckles.

**Note:** If any of the standard CASS™ system posts are within 1 foot from the turnbuckles, a CASS™ system splice post with a straight cut notch to allow the turnbuckle to move through should be applied.

Approximately three to four weeks after the completion of the tensioning of the cable, the cable tension must be checked again and adjustments made as required.
**Delineation**

The specifying agency should establish the criteria as to delineation of the posts. The delineation will be provided on the spacers used to separate the cables. For the CASS™-TL3 system, typically both spacers will have reflective sheeting applied. For the CASS™-TL4 system, only the top spacer will have reflective sheeting applied *(See Figure 14).*

![Figure 14 Reflective Sheeting on Spacer](image)

It is suggested for the terminal CRP that reflective sheeting be affixed to delineate assembly which could help to reduce some accident impacts. It is recommended that all of the posts be delineated. The minimum is to delineate the three CRP on the approach side of the approach terminal and the 3rd CRP on the approach side of the departing terminal.

**Tensioning Meter**

It is important to review the manufacturer’s complete instructions included with the tensioning meter prior to tensioning of the cable.

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Repair After Impact

**WARNING:** If it is necessary to totally remove the fitting ends from the turnbuckle, the tension must first be released on the assembly by means of a come-along, backhoe, or other mechanical means. Failure to follow this warning can result in serious injury or death to the worker and/or bystanders. Please clear all pedestrians, law enforcement, emergency personnel, and any individuals not specifically authorized by the appropriate highway authority to repair a cable under tension, after any impact to the system. An impact may sever or weaken the tensioned cable and special care should be undertaken to clear everyone in the proximity of an impacted system.

After an impact, the system will require repair. Impact testing conducted in conformance with NCHRP Report 350 indicates that the cable will typically maintain its original height and may be able to withstand additional hits. Even with this capability, it is recommended that the system be repaired as soon as possible and its suitability should be thoroughly assessed by the appropriate state or specifying agency. After most impacts, the system can be repaired in a relatively short period of time. Any part or parts which appear broken, worn, torn, and/or damaged must be replaced. Adding specific parts to the CASS™ system, is a decision that must be made by the appropriate state or specifying agency.

An impact that encounters a CASS™ Cable Terminal (CCT) may require the re-tensioning of the entire run of cable. After repairing the cable, the tension throughout the system should be checked.

It is recommended that for impacts with vehicles larger than those used in the NCHRP Test Level 3 or Test Level 4 tests, the cable should be checked to determine if it needs to be re-tensioned.

**Repair for System Impact (CCT not Damaged)**

If an impact occurs and the CCT is not involved, usually only the posts will have to be replaced and the cables re-inserted in the posts. The following steps should be followed in making this repair:

1. Inspect the damaged system and determine what material will be required to make the repairs.
2. Remove the damaged posts. They should come out of the sockets easily. During very cold weather and in Northern climates, the post may become frozen into the socket. Successful means of extraction have utilized propane torches or a hammer drill to break up the ice. Calcium chloride (a common deicing chemical) can also be mound over the top of the ice for 24 hours prior to removal of the post. As always, wear appropriate safety equipment such as gloves and safety goggles during post removal. If the posts are driven, they will have to be pulled out of the ground.
3. Place new posts in place of damaged ones. The C-channel posts shall be paired with every other post being rotated 180 degrees *(See Figure 15)*.

![Figure 15 Post Orientation](image)

4. If this is a three cable system, place the bottom cable in the post slot, followed by the appropriate CASS™ system spacer.
5. Place the middle cable in the post slot, followed by the appropriate CASS™ system spacer. Place the stainless steel strap on the post above the middle cable.

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6. Place the top cable in the post slot.
7. If this is a four cable system, place the bottom cable in the post slot.
8. Place the 2nd cable in the post slot, followed by the appropriate CASS™ system spacer.
9. Place the 3rd cable in the post slot, followed by the appropriate CASS™ system spacer. Place the stainless steel strap on the post above the 3rd cable.
10. Place the top cable in the post slot.
11. If the post caps are used, place them on the posts.
12. Depending on the severity of the impact, after the repair, the cable might have to be re-tensioned. If the cable is standard and has been assembled less than 2 years, the tension on the cable should be checked with the tension meter and adjustments made at the turnbuckles to bring the cable to the correct tension based on either the ambient air temperature or the cable temperature and the values on the CASS™ System Temperature / Tension chart.

Note: The reflective sheeting may be placed on the post caps or the spacers for the CASS™ system and on the CASS™-TL3 and the CASS™-TL4 system spacers based on the agency’s specification.

**Repair for CCT Impact**

When the cable has been impacted and the Controlled Released Post(s) (CRP) of the CCT is not involved, the following steps should be followed:

1. Remove the damaged post(s).
2. Emplace new terminal line post(s) that need to be replaced.
3. Attach the cables to the new terminal line post(s). Refer to the Assembly Manual for the attachment of the cable(s).
4. Check the cable tension at turnbuckle downstream from the CCT to ensure that the tension is within tolerances.

When the cable has been impacted and the Controlled Release Post(s) (CRP) of the CCT is involved, the following steps should be followed:

1. For the CRP(s) that have been impacted, inspect the top and bottom post for damage. Repair or replace any damaged posts.
2. Remove the turnbuckle(s) that connects the terminal cable(s) to the line cable(s) that have been released from the Controlled Release Post(s).
3. Attach the top CRP to the bottom CRP. Refer to Figure 4 in this Manual for the placement of the CRP (See Pages 12 and 13).
4. Place or drive new terminal line post(s) that need to be replaced.
5. Attached the cable to the CRP and terminal line post(s). Refer to the Assembly Manual for the assembly of the cable(s). If any of the terminal cables were damaged, they should be replaced and attached to the CRP and terminal line posts.
6. The CCT cable(s) and line cable(s) released in Step 2 should be reconnected. The cable(s) can be connected by the use of a backhoe, come-along, or other mechanical means.
7. Check the cable tension at the CCT turnbuckle and downstream from the CCT to ensure that the tension is within tolerances.
Repair for Cable Transition to W-Beam (CTW) or Rail Element(s)

When an impact occurs with rail elements that have a Cable Transition to W-Beam (CTW) connected to them and the impact is more than 200 feet from the transition, the damaged guardrail system can be repaired by completing the normal guardrail procedures.

When the impact occurs within 200 feet of the transition and only post(s) are damaged, the post(s) can be replaced by completing the normal guardrail procedures.

When the impact occurs within 200 feet of the transition and rail panel(s) are damaged and need to be replaced, the repair procedures below should be followed:

1. Before the rail splice bolts are removed, secure the guardrail system to prevent the post(s) from leaning over when the panel(s) is removed. This is done by the use of a come-along or other mechanical means.

2. Once the post(s) are secured, the rail panel(s)/post(s) can be removed and replaced by following the normal guardrail procedures for the placement of guardrail.

3. After the rail panel(s) is replaced, the devices used to secure the guardrail system can be loosened and removed.

If the rail panel(s) of the CWT is damaged, the repair procedures below should be followed:

1. Place a mark on the fittings at the end of the turnbuckles and at the anchor bracket cable end.

2. Release the tension on the cables at the turnbuckle and remove the cable from the anchor brackets.

3. Replace the rail panels and posts as needed.

4. Place the cable in the brackets and attach the nuts. The nuts attached to the fittings should be located on the mark made before removing them.

5. The cables should be re-tensioned by connecting the cable fittings to the turnbuckles. Insert the fittings into the turnbuckles to the mark made before doing the un-tensioning.

6. Re-check the tension at each turnbuckle as necessary.
Emergency Repair

There could be an occasion when an accident could cause significant traffic congestion, or the cable can be entangled with the vehicle. Whenever a vehicle is entangled in the cable, the first step that must be undertaken is to move or drive the vehicle as close to the centerline of the cable system as is feasible, in order to reduce tension. Here are some suggestions on how to get traffic moving or the cable untangled. Again, all individuals not specifically designated by the appropriate highway authority, who specified the deployment of this system, to perform repairs to it, must be removed from proximity to the system.

Road Blocked Due to an Accident

To resume traffic flow after an accident or to get emergency vehicle(s) access to the accident site, crossover access through the cable may be necessary. To provide this access, remove cables from several posts upstream and downstream of the desired opening. The opening width can be adjusted by removing posts from the ground sleeves. The cable can be held down and the traffic or emergency vehicle(s) can pass over it.

In life threatening or emergency situations the cable can be cut. If the cable was put under additional tension due to the accident, the tension can be reduced at the turnbuckles closest to the impact. The threads outside of the turnbuckle must be marked, and the turnbuckle backed off no more than 3/4". To reduce the amount of cable damage during cutting, duct tape must be wrapped around the cable and the cut made through the tape. Some agencies have also cut through the turnbuckle itself. This will reduce the maintenance / repair effort. When cutting through a turnbuckle, make sure that all posts, both upstream and downstream for a distance of 50 feet, are removed in order to prevent turnbuckle or fitting interference.

In addition, if the entangled vehicle is located near the CCT (terminal) end, it is possible to reduce tension by backing off the two large 1" nuts on the terminal cable end.

DO NOT REMOVE THE NUTS!
Repair of a Cut or Damaged Cable

Below are various methods to repair cable that has been cut or damaged.

METHOD 1 – Splicing the Cable
Splicing the cable may be necessary if a cable is cut or damaged during an impact, which is rare. The length of the cable must be **50 feet or longer** to make the splice and must be obtained.

1. Re-cut the ends of the cable to ensure the ends are clean and smooth.
2. Refer to the Assembly Manual when making a cable splice connection.
3. If an accurate length of cable is used for the splice section, two cable splice connectors will be required to connect the cables together.
4. Connect one end of the splice cable to one end of the cut cable with a connector.
5. Next, apply another connector to the other end of the splice cable and the end of the cut cable.
6. Assemble the cable splice connector by using a backhoe or other mechanical means.
7. Check the tension on the cable with the tension meter and adjust the turnbuckles to bring the cable to the correct tension based on the ambient air temperature or the cable temperature and the values on the CASS™ System Temperature and Tension Chart.

**Note:** If the cable splice has been cut accurately, the tension may be obtained by turning the turnbuckles at each side of the cut. If the tension cannot be obtained at the turnbuckles at each side of the splice, it may be necessary to re-tension the cable at the end of the cable run where the field splice was made. The field splice should be removed, cable measured, cut, and re-connected with the correct tension. Follow the procedures in this Assembly Manual when doing the re-tensioning. Some assemblies may have field splices at all locations. If this is the case, then the measuring, cutting, and re-connecting can be done at any location.

METHOD 2 – 5-Foot Section
A second method to reconnect the cables is to use a 5-foot section of cable with factory applied fittings on each end. This method will also require two (2) turnbuckles and a left-hand and right-hand threaded fitting to complete the connection.

1. Remove 9’8” of cable from the cut cable.
2. Attach the threaded fittings and the cable ends connection per the Cable Barrier End Treatment Section of this Manual (See Page 12).
3. Re-tension the cable with two (2) turnbuckles by inserting them into the system.

METHOD 3 – Other Than 5 Feet Cable
When using a cable length other than 5 feet, the amount of cable removed from the cut cable should be adjusted based on the cable length removed.

1. If the length of cable used is less than 5 feet, remove less than 9’8” of cable from the cut cable.
2. If more than 5 feet of cable is used, remove more than 9’8” of cable from the cut cable.
3. To help to determine the amount of cable to be removed, after the threaded fittings are affixed on the piece of splice cable, take a measurement from end of fitting to end of fitting. Take this measurement and add 4’6” and this will be the amount of cable to be removed from the cut cable.
METHOD 4 – Use of Fitting Connections Only

If the damaged cable after cutting is less than a total of 4’6”, the connection can be made with a left and right threaded fitting and a turnbuckle.

1. Remove 4’6” of cable from the cable run.
2. Place a left-hand threaded fitting on one end of the cut cable and a right-hand threaded fitting on the other end of the cut cable.
3. Follow the procedures in the Assembly Manual for connecting the two ends using the turnbuckle.
4. Check the tension on the cable with the tension meter and adjust the turnbuckles to bring the cable to the correct tension based on the ambient air temperature or the cable temperature and the values on the CASS™ System Temperature and Tension Chart (See Page 32).
Trinity Highway Products, LLC  
CASS™ System  

**Tension Log Form**

**Project:** ____________________________________________________________

**Date of tensioning:** __________________________

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**Notes:**
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**Signature:** __________________________________________

(Print Name)
**CASS™ System Temperature and Tension Chart (A)**

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* Tolerance: –200 to +800 pounds
### CASS™ System Temperature and Tension Chart (B)

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*Tolerance: –91 to + 363 kilograms