CASS® TL-3
(Utilizing C-Shaped Post)

Assembly Manual

Part No. 620289B

Revision March 2007

TRINITY
HIGHWAY PRODUCTS
ENERGY ABSORPTION SYSTEMS

INDEX

IMPORTANT NOTICE

These instructions are to be used only in conjunction with the installation of the CASS^{TM} system. These instructions are for standard installations only. **In the event your system installation requires or involves special circumstances, or during the installation process a question arises regarding a particular instruction, contact Trinity Highway Products, LLC (THP) representative before proceeding.**

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INTRODUCTION

These instructions should be carefully read entirely before installation of the CASS^{TM} system.

A set of product and project shop drawings will be supplied by THP. The shop drawings will be for each section of the cable installation. See the Drawings Section for an example of the shop drawings. These drawings should be reviewed and studied thoroughly by a qualified individual before the start of any installation.

GENERAL DESCRIPTION

The CASS system is a 3-Cable Barrier System. The CASS system consists of 4 inch (100mm) wide C-Channel posts and three (3) pre-stretched ¾ inch (19mm) cables or three (3) standard ¾ inch (19mm) cables. The cable are placed in a slot at the top of the posts at heights of 20.9" (530mm), 25.2" (640mm), and 29.5" (750mm). Plastic spacers keep the cable properly positioned at 4" (100mm) on center for. A stainless steel strap is placed around the post between the top and middle cable. The post spacing will be as per the contract plans with 16'5" (5 meters) being the maximum spacing. The barrier is terminated either with a CASS^{TM} Cable Terminal (CCT), a CASS^{TM} Cable Anchor (CCA), a CASS^{TM} Transition to W-Beam (CTW) or Thrie Beam (CTT), a CASS^{TM} Transition to Box Beam (CTB), a CASS^{TM} Transition of a Colorado 3F, or a Bracket connected to a barrier (CB).

GROUND PREPARATION AND BARRIER ALIGNMENT

The CASS system shall be installed 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 installer shall "flatten" or "round" various topographical inconsistencies that could interfere with the ability of the installer to consistently maintain the design height (in relation to the terrain) of the cables.

When cable is placed on a ditch section and a vehicle can strike it after crossing the ditch, the agency's policy should be followed when the slopes are steeper than 10:1 and the cable in an area of 1 to 8 feet from the ditch bottom.

To prevent debris from collecting in the footing sockets, the CASS system should not be placed in the bottom of the median ditch or shoulder ditch.

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 installed behind the curb in an area from 1.5 to 8 feet. When the CASS system needs to be installed on roadways with a speed of 40 mph or less, and a curb is present, contact a THP representative before proceeding.

If the barrier must be flared, the flare rate is 30:1 or flatter. See the Drawing Section at the installation instructions for the installation.

The agency's standards for grading and widening for guardrail terminals should be used for the CASS Cable Terminal.

LAYOUT

For an aesthetically pleasing installation, it is important that care is taken 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.

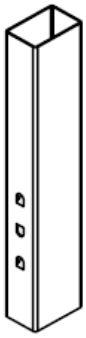
POSTS AND POST FOUNDATIONS

Post

The CASS system posts can be driven, installed in a driven sleeve, with and without a soil plate, installed in a sleeve in a concrete footing (poured or pre-cast), or mounted to a concrete surface. Driven CASS^{TM} posts are 72" long. For posts installed in a sleeve, the CASS^{TM} posts are 47 1/4" long. For posts mounted to a concrete surface, the CASS^{TM} post is 31 5/8" long. These lengths are for the concrete surface flush with the ground.

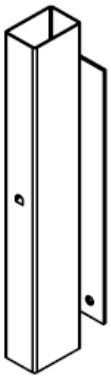
Post Foundations (Line Posts)

The driven sleeves are 31 inches in length and the sleeves installed in a concrete footing are 27 inches long **(See Figure 1).**



Sleeve For Concrete Footing

Driven Sleeve



Driven Sleeve with Soil Plate

Figure 1
Post Sleeves

For post spacing of 20' or less, the concrete footings are 12 inches in diameter and a minimum of 30 inches deep. For post spacing of 21' to 30', the concrete footings are 12 inches in diameter and 42 inches deep. The concrete strength shall be 3000 psi or greater if necessary to meet an agency's specifications. The concrete footing can be poured in augured or punched holes or pre-cast and installed in augured or punched holes.

The 27-inch sleeve is installed. A plastic cap is placed on the bottom end of the sleeve to prevent the concrete from coming up from the bottom. A #3 rebar ring is placed around the top of the sleeve 2 to 3 inches from the top of the footing. The sleeve is inserted and centered in the concrete after it is poured. A vibrator is helpful to get the sleeve into the concrete. **The sleeves must be plumb.** To keep the sleeves on alignment, use a string line and level, or other appropriate means.

The C-channel posts shall be installed with every other post being rotated 180 degrees (**See Figure 2**).

Figure 2
Post Orientation

A plastic cover can be placed on the post to keep debris out of the sleeve (**See Figure 3**)

Figure 3
Plastic cover for post

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

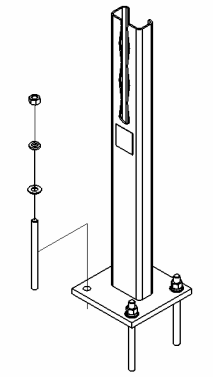


Figure 4
Base Plated Post

POST SPACING ON A CURVE

When the cable is installed on a curve, it may be required to reduce the post spacing based on the curve radius. The post spacing criteria for a curve will be the same for both pre-stretched and standard cable.

If weak soil conditions require larger footings for the Cable Release Posts of the CASS Cable Terminal, larger footings may also be required for the line posts of the CASS system as it installed along a curve and/or post spacing may need to

be reduced further than shown in the criteria below. **It is imperative before installation that you contact a THP representative for special criteria for weak soil conditions. In some cases it may require that an engineer or other qualified professional be contacted.**

The following is the post spacing for installations on a curve:

Radius less than 650 feet, contact a THP representative.

Radii 650 feet to 1300 feet, use 10 foot post spacing or less if specified by an agency.

Radii 1301 feet to 2250 feet, use 16.5 foot post spacing or less if specified by an agency.

Radii greater than 2250 feet, use project post spacing or less if specified by an agency.

If any of the post spacing for a particular radii grouping is larger than the project post spacing, then the project post spacing should be used.

INSTALLING POST SLEEVES/POSTS WHEN ENCOUNTERING ROCK

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

Post Sleeve

If rock is encountered and 9 inches or less depth into the rock is required to complete the installation of the full sleeve, drill 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 installed the same as would be for the concrete footing including the rebar ring.

If rock is encountered and more than 9-inch depth into the rock is required to install 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 that there must be 3 inches of concrete below the sleeve.** Fill the hole with 3000 psi concrete. The sleeve should be installed the same as would be for the concrete footing including the rebar ring.

Driven Post

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

If rock is encountered and more than 18-inch depth is required to install 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 installed at the proper mounting height. Backfill and compact the hole after installing 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 installation of the full hole, drill a 18 inch diameter hole to the required depth in the rock. Install 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 install the full re-bar, 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 that there must be 3 inches of concrete below the rebars.** Install the re-bars 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™ barrier is terminated with a CASS™ Cable Terminal (CCT), CASS™ Cable Anchor (CCA), a CASS™ Transition to W-Beam (CTW) or Thrie Beam (CTT), CASS™ Transition to Box Beam (CTB), Transition to Colorado 3F or a CASS™ Bracket (CB).

CASS™ Cable Terminal (CCT)

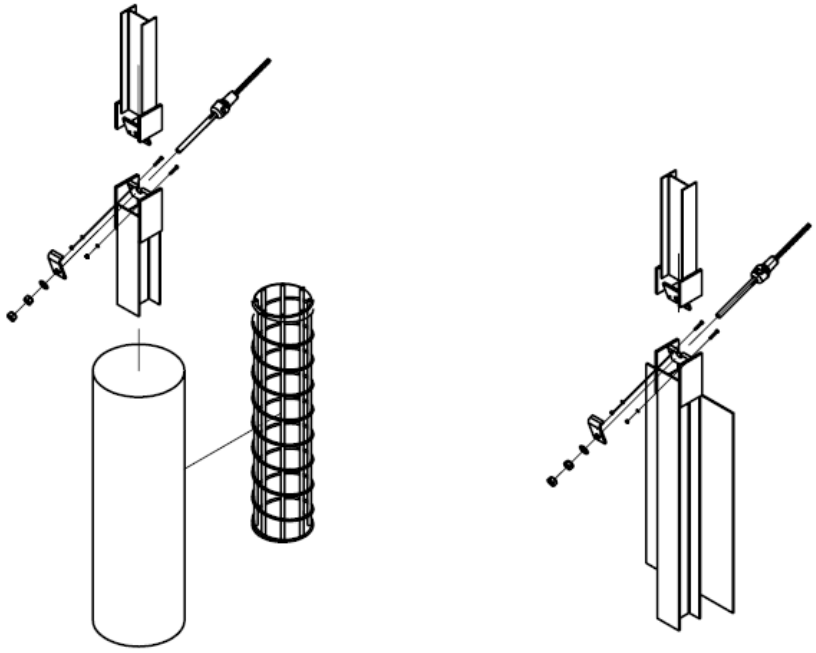
The CASS™ Cable Terminal (CCT), NCHRP 350 approved, consists of three (3) Cable Release Posts (CRP) and six (6) S3x5.7 posts. The posts are 5’3” long for the CASS-TL3 system and 5’3” to 5’11” long for the CASS-TL4 system (See the Drawing Section post locations). The cables are terminated at the CRP posts, 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 tie wired 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 it height and alignment during the concrete pour. The upper post is attached to the stub post with two (2) 5/16" x 2" bolt, 5/16" nut and 5/16" washer assemblies **(See Figure 4)**.

For a soil plate installation, the 5'0" bottom post with a 2'0" x 4'0" soil plate can be driven or installed in an augured hole. The hole should be augured about 4 feet or less deep and 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 installed as described above.

The top of the bottom post for either installation shall not be more than 4 inches above the ground line.



Concrete Footing **Soil Plate Footing**

Figure 4
CRP Footing Detail

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. **Posts 1 and 3 will be located on the traffic side or side nearest to the traffic.** If the CASS^{TM} is installed on the centerline of the median, Posts 1 and 3 should be installed on the side of the approaching traffic end of the installation. See **Figure 5** for the CRP layout.

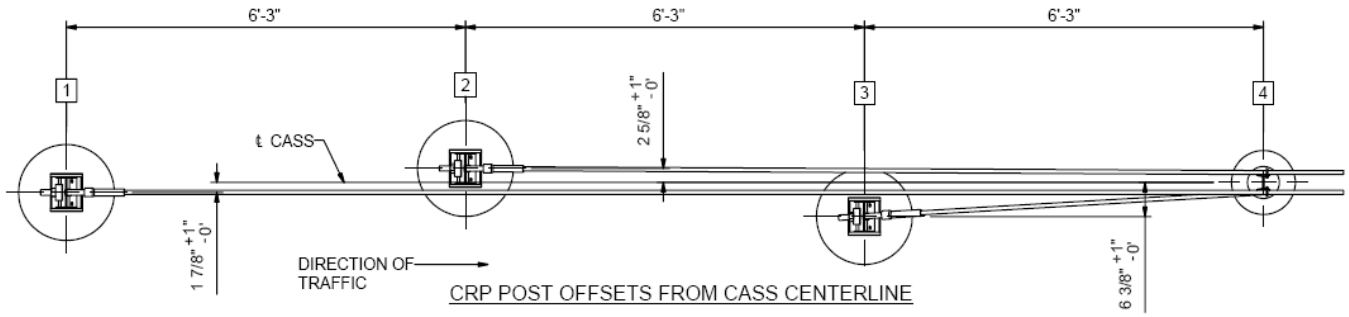


Figure 5
CRP Layout

Posts 4 through 9 are installed 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 ¾" 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 inches 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. The concrete footing is 12 inches in diameter and 3 feet deep. A #3 rebar ring is place around the top of the sleeve, 3 inches from the top of the footing. Two (2) #4 rebars x 2'-9" 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 augured, the material should be compacted after installation. At post 4, two (2) bearing angles are secured to the post at the ground line **(See Figure 6)**.

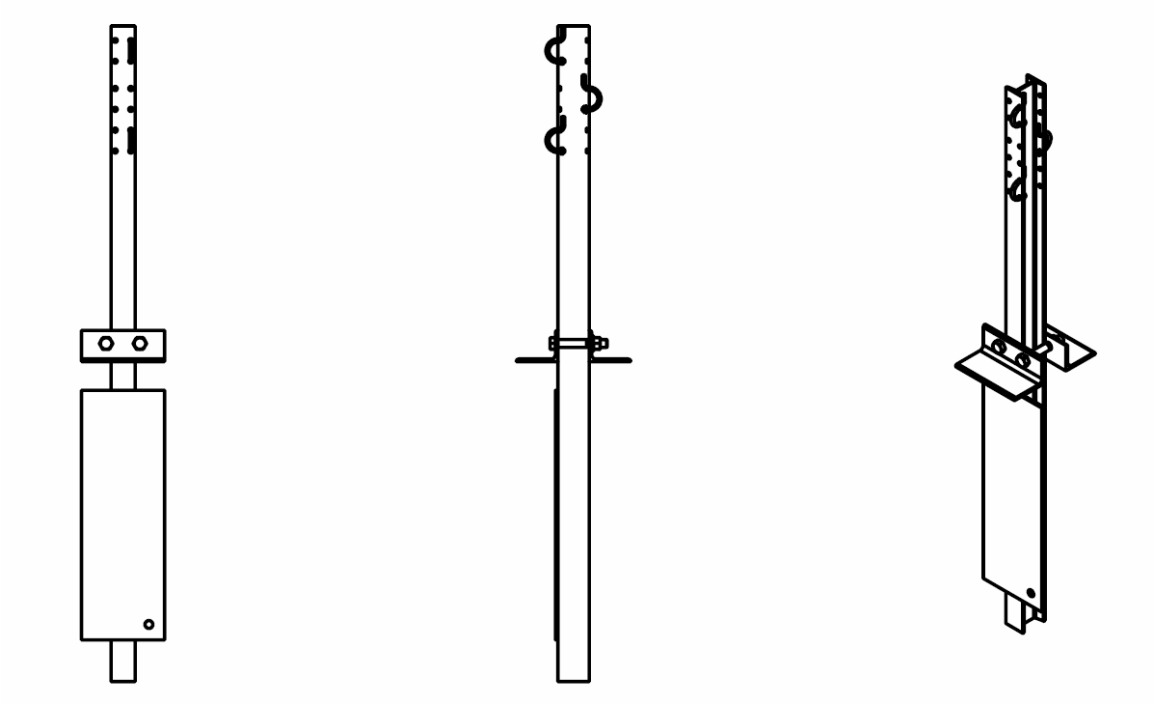


Figure 6
Bearing Angles for Post 4

The CCT cables are connected to the CRP's by inserting the right hand fitting (red end) through the 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 installed on 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 threads between the end of the fitting and the nuts.

The CCT cables are installed 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: The top and bottom cables are installed at 21 and 29.5 inches above the ground. The middle cable is installed 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: At post location 9, the top, middle, and bottom cables are installed 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 post 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. See **Figure 7** for the installation of the hook bolt.

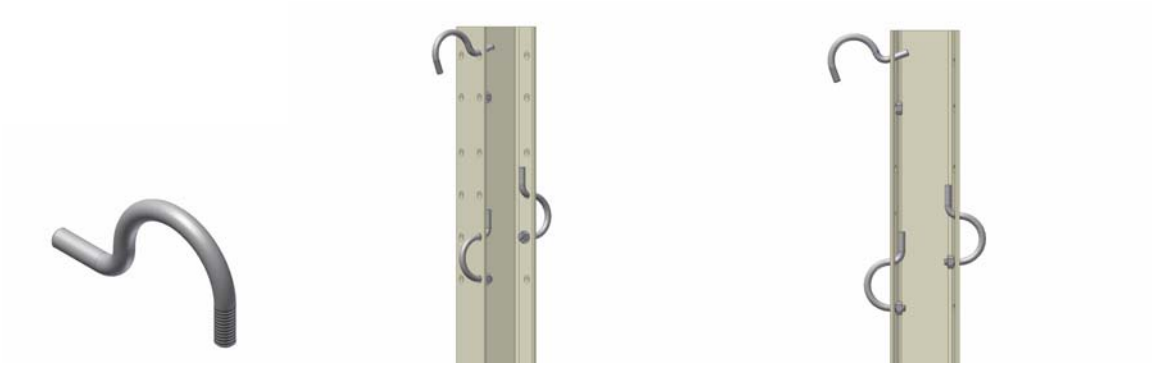


Figure 7
Installation of the Hook Bolt

The hook bolts should be installed with just 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), non NCHRP 350 approved, consists of an anchor block, a bracket to secure the cable to the anchor, two (2) CASS™ 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 60 inches long, 40 inches wide and 40 inches deep (**See Figure 8**). The state's standards may require a larger footing.

Eight (8) ¾ inch 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, the anchor bolts can be installed in the footing by drilling eight (8) 1-inch diameter x 12 in deep holes. The 3/4 inch anchor studs can be installed with an approved anchoring adhesive.

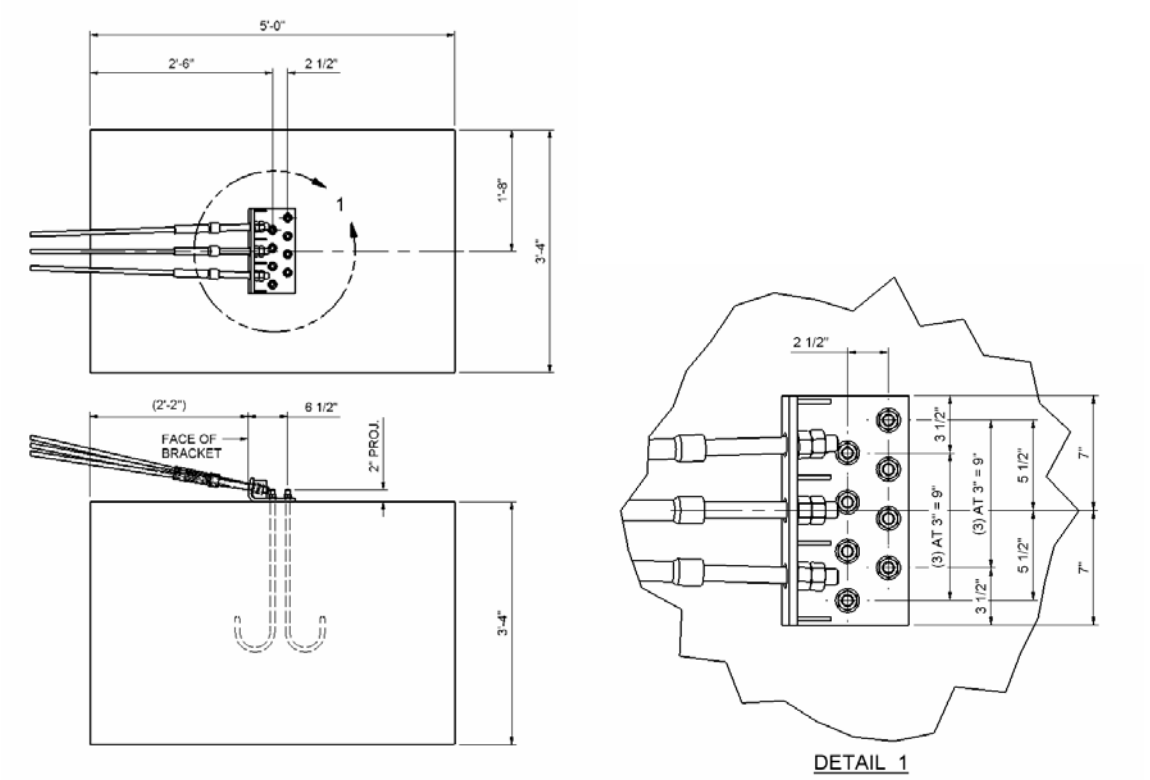


Figure 8
CCA

Once the concrete has reached 3000 psi with the anchor bolts (A307) installed, the anchor bracket is secured to the footing with ¾"flat washers (F844) and ¾" hex nuts (A563).

The first CASS™ post is installed 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 installed 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™ post is placed 10 feet on center from the first CASS™ 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™ 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 crash worthy guardrail terminal.

The CTW or CTT consists of first installing the W-Beam or thrie-beam rail system, including the terminal. See the Drawing Section for the guardrail layout. Bolt the anchor brackets to the backside of the rail panel(s). CASS™ posts or footings and posts are then installed. See the Drawing Section for the post spacing. After the posts are installed, the appropriate cables are placed through the slots in the rail panels and secured to the anchor brackets. The cable is secured with two (2) 1" hex nuts (A194 2H) and a 1" washer (F436). The cable is next installed in the posts the same as the line cable is installed, except the spacers for the first post are metal round spacers, or a 1-inch thick rubber spacer or approved alternate, not the standard plastic 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 an impacting vehicle will not impact the end of the system.

CASS™ Transition to Colorado 3F

This installation would be the same as for the Transition of 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 installations 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 ¼ inch plate on the traffic side.

CABLE INSTALLATION

Once the posts and terminals are installed, 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 installations 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 yellow. 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 reattached 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 installed on each end.

Non-Standard Lengths

The non-standard lengths to complete the installation 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 installed after it is cut to length.

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

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 installed per the terminal/anchor installation 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 installations 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 installed on the other end.

The first right-hand fitting to be removed from the reel will be painted yellow. 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 reattached 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 installed on each end.

Non-Standard Lengths

The non-standard lengths to complete the installation 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 installed after it is cut to length.

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

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 installed per the terminal/anchor installation 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)**.

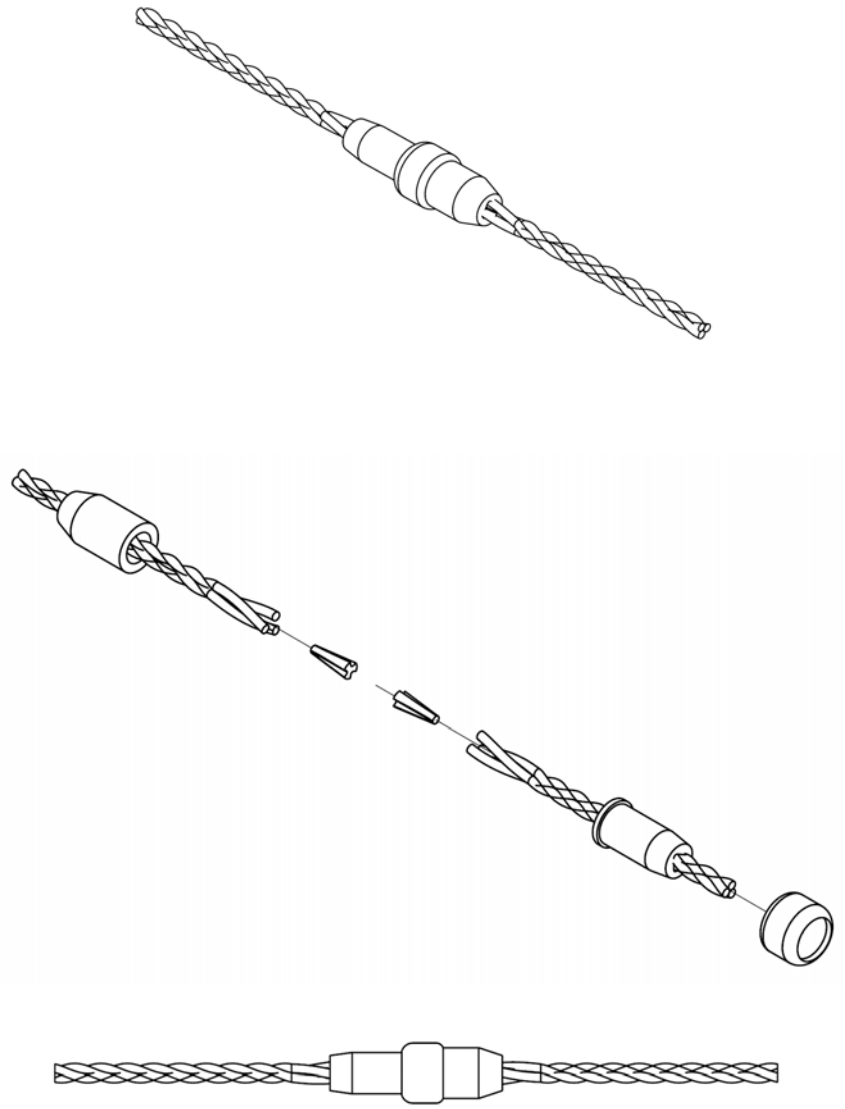


Figure 9
Cable Splice

The **<u>right-hand fitting end</u>** 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

Each threaded rod should be screwed in at least 1-½ inches into the turnbuckle (visible in the sight hole) to assure the continuity of the strength of the cable. The cables are unspoiled 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 placed, a plastic spacer is installed in each post **(See Figure 11)**.

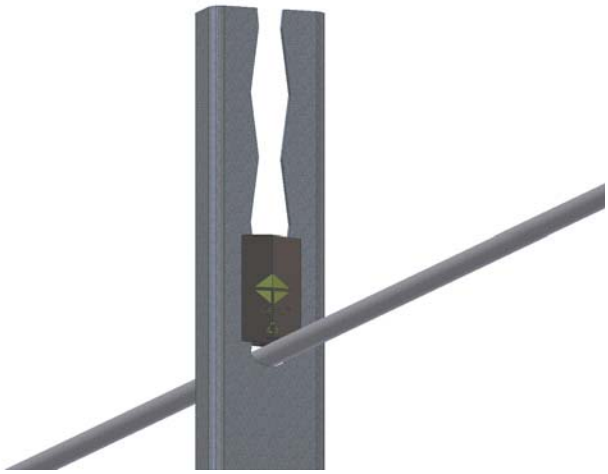


Figure 11
1st Cable and Spacer Installed

The middle cable is then placed in all of the posts. A plastic spacer and the stainless steel metal band are then installed (**See Figure 12**).

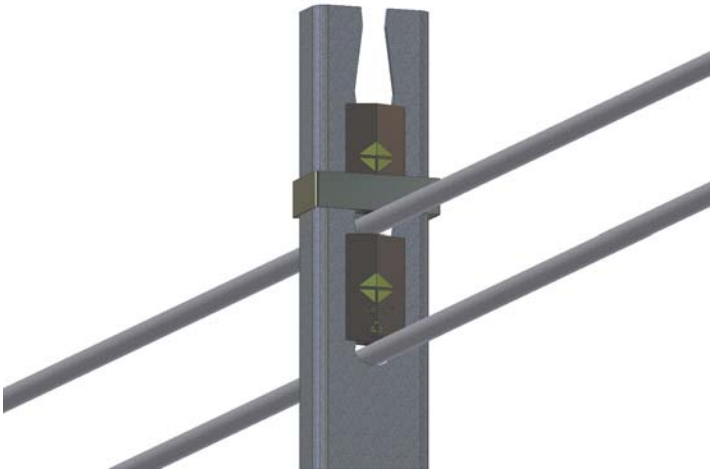


Figure 12
2nd Cable, Spacer, and
Stainless Steel Strap Installed

The top cable is then installed (**See Figure 13**).

Figure 13
3rd Cable Installed

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 holes on each end of the turnbuckle.

TENSIONING AND FIELD CONNECTION

Once all of the cables have been installed in 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™ Temperature and Tension Chart** for the tension requirements. Each Cass installation will require at least one field connection per cable to complete the installation. There may be cases where the contractor may elect to complete all of the connections with field splices. The field splice must be installed correctly to ensure the connection will not separate.

The field connection is made by first gradually pulling the **bottom cable** using a backhoe or other means and then backing off. The cable is then pulled again gradually to the required tension. The cable is marked where it meets the terminal or transition cable.

To make the field splice, the end of the cable must have a clean square cut. This can be done with a saw with an abrasive blade or an electric band saw. Insert the cut end of the cable into the field casting through the triangular end. With the cable inside the casting, the cable is separated with two flat head screw drivers so the tapered triangular wedge can be inserted. The wedge is inserted into the cable with the smaller diameter end towards the triangular hole. All three strands of the cable are to be located in the appropriate grooves of the wedge. The wedge must be pushed ½-inch beyond the end of the cable (plus or minus 1/8-inch). With the wedge installed, a hammer is used to seat the wedge by hitting on the triangular end of the casting. Several hits should be made to seat the wedge. After the wedge is properly seated, one wire of the cable must be bent over the end of the wedge.

If utilizing 1-inch field applied fittings, a 1-inch nut is placed inside the casting and the 1-inch threaded rod is inserted through the hole of the casting and screwed into the nut. This will be a right-handed threaded rod. The terminal or transition cable end will be a left-handed threaded end. The 1-inch threaded rod must be

screwed into the nut until all threads are utilized of the rod is against the end of the cable.

If utilizing ¾-inch field applied fittings, a ¾-inch nut is placed inside the casting and the ¾-inch threaded rod is inserted through the hole of the casting and screwed into the nut. This will be a right-handed threaded rod. The terminal or transition cable will be a left-handed threaded end. The ¾-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 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.

Once the fittings are installed, the cable is pulled again and connected to the terminal or transition end using a turnbuckle. The final tension based on the Temperature/Tension Chart is then placed on the cables by turning the turnbuckles as necessary. See the Tensioning Meter Section for measuring the tension.

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 installation 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 reinstalled 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. **If any of the standard CASS^{TM} posts are within 1 foot from the turnbuckles, a CASS^{TM} splice post with a straight cut notch to allow the turnbuckle to move through should be installed.**

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 state 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^{TM}-TL3 system, typically both spacers will have reflective sheeting applied. For the CASS^{TM}-TL4 system, only the top spacer will have reflective sheeting applied **(See Figure 14)**.

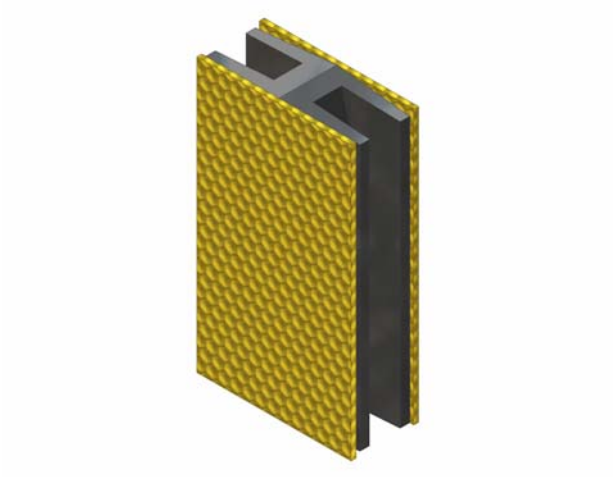


Figure 14
Reflective Sheeting on Spacer

It is suggested for the terminal CRP that reflective sheeting be installed to delineate them 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 manufactures complete instructions included with the tensioning meter prior to tensioning of the cable.

Trinity Highway Products, LLC
Cable Safety System (CASS™)

Tension Log Form

Project:_____

Date of tensioning:_____

RUN	STA. TO STA (MP TO MP)	AMBIENT TEMP.	DESIGN LOAD	ACTUAL LOAD
1. _____	_____	_____	_____	_____
2. _____	_____	_____	_____	_____
3. _____	_____	_____	_____	_____
4. _____	_____	_____	_____	_____
5. _____	_____	_____	_____	_____
6. _____	_____	_____	_____	_____
7. _____	_____	_____	_____	_____
8. _____	_____	_____	_____	_____
9. _____	_____	_____	_____	_____
10._____	_____	_____	_____	_____

Notes:_____
_____
_____

Signature: _____

_____
(Print Name)

CASS™ TEMPERATURE AND TENSION CHART

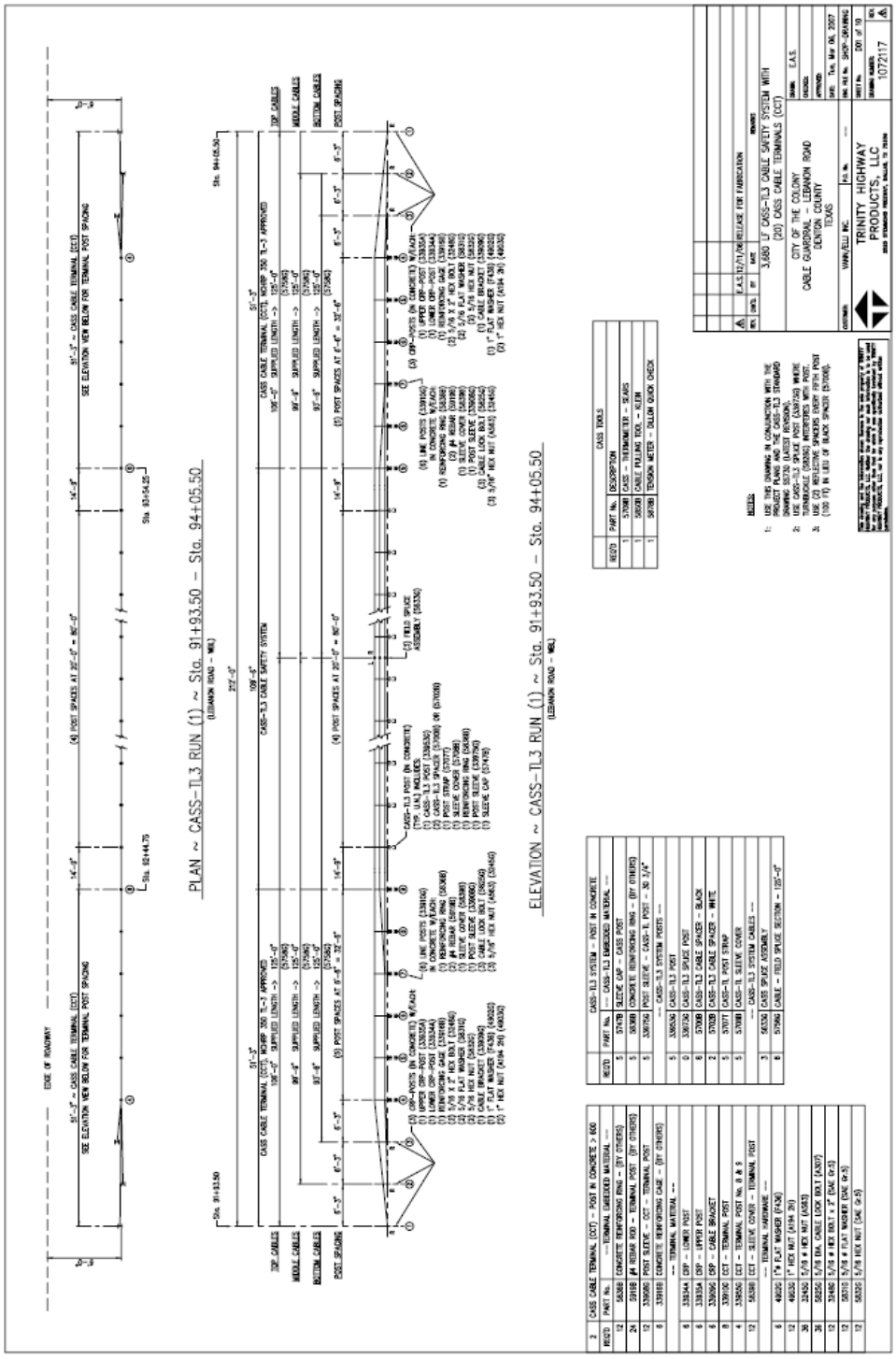
Pre-Stretched Cable		Standard Cable	
°F	Tension (lbs)*	°F	Tension (lbs)*
-15	7500	-15	8800
-10	7300	-10	8600
-5	7100	-5	8400
0	7000	0	8200
5	6800	5	8000
10	6600	10	7800
15	6500	15	7600
20	6300	20	7400
25	6100	25	7200
30	6000	30	7000
35	5800	35	6800
40	5600	40	6600
45	5500	45	6400
50	5300	50	6200
55	5100	55	6000
60	5000	60	5800
65	4800	65	5600
70	4600	70	5400
75	4500	75	5200
80	4300	80	5000
85	4100	85	4800
90	4000	90	4600
95	3800	95	4400
100	3600	100	4200
105	3500	105	4000
110	3300	110	3800
115	3100	115	3600
120	3000	120	3400
125	2800	125	3200
130	2700	130	3000
135	2600	135	2900
140	2500	140	2700
145	2400	145	2500
150	2300	150	2400
160	2100	160	2200
170	1900	170	2000
180	1700	180	1800
190	1500	190	1600
200	1300	200	1400

* **Tolerance: –200 to +200 pounds**

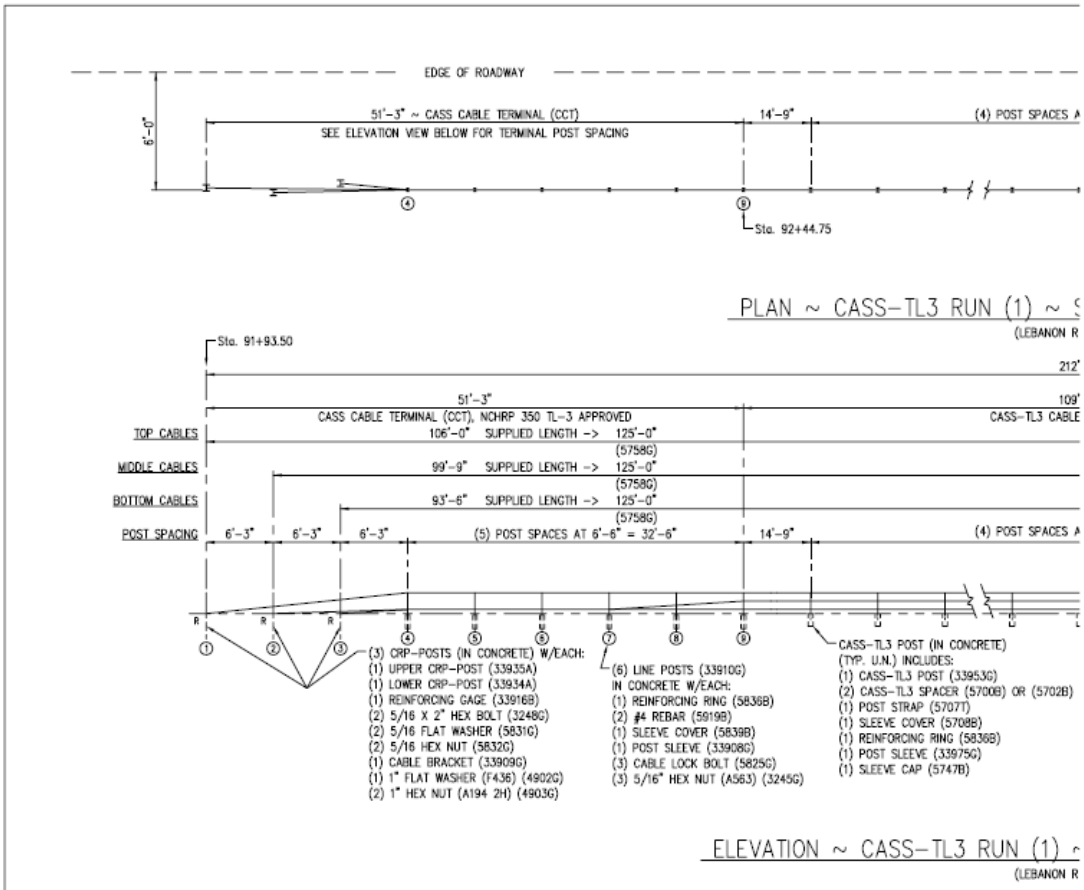
DRAWINGS

CASS™ Terminal, Anchor, and Transition Drawings **Drawing No.**

Contact your Trinity Highway Products Representative for Drawings



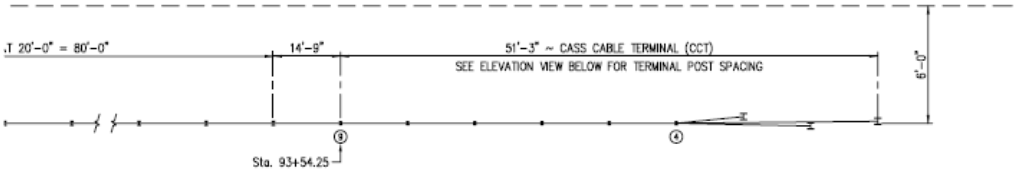
SHOP DRAWING



2	CASS CABLE TERMINAL (CCT) - POST IN CONCRETE > 600	
REQ'D	PART No.	--TERMINAL EMBEDDED MATERIAL --
12	5836B	CONCRETE REINFORCING RING - (BY OTHERS)
24	5919B	#4 REBAR ROD - TERMINAL POST (BY OTHERS)
12	33908G	POST SLEEVE - CCT - TERMINAL POST
6	33916B	CONCRETE REINFORCING CAGE - (BY OTHERS)
		-- TERMINAL MATERIAL --
6	33934A	CRP - LOWER POST
6	33935A	CRP - UPPER POST
6	33909G	CRP - CABLE BRACKET
8	33910G	CCT - TERMINAL POST
4	33955G	CCT - TERMINAL POST No. 8 & 9
12	5839B	CCT - SLEEVE COVER - TERMINAL POST
		-- TERMINAL HARDWARE --
6	4902G	1"ø FLAT WASHER (F436)
12	4903G	1" HEX NUT (A194 2H)
36	3245G	5/16 ø HEX NUT (A563)
36	5825G	5/16 DIA. CABLE LOCK BOLT (A307)
12	3248G	5/16 ø HEX BOLT x 2" (SAE Gr.5)
12	5831G	5/16 ø FLAT WASHER (SAE Gr.5)
12	5832G	5/16 HEX NUT (SAE Gr.5)

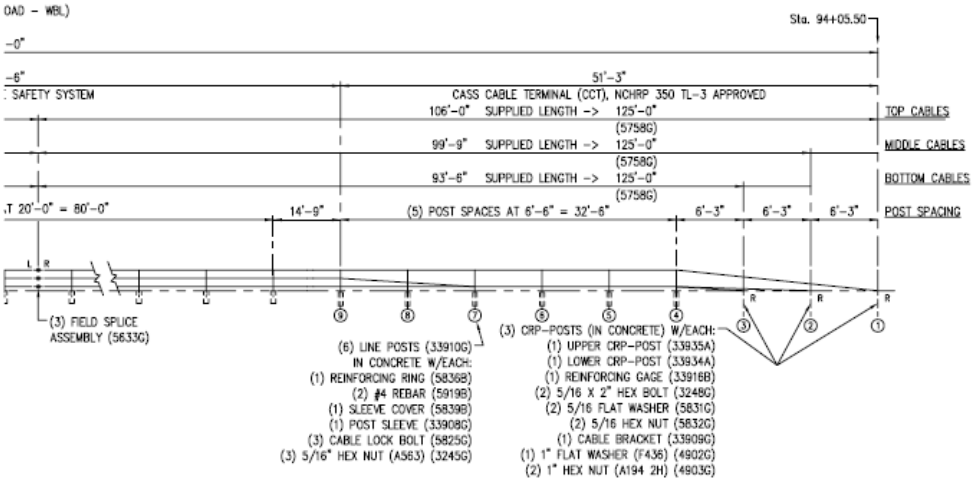
	CASS-TL3 SYSTEM - POST IN CONCRETE	
REQ'D	PART No.	-- CASS-TL3 EMBEDDED MATERIAL --
5	5747B	SLEEVE CAP - CASS POST
5	5836B	CONCRETE REINFORCING RING - (BY OTHERS)
5	33975G	POST SLEEVE - CASS-TL POST - 30 3/4"
		-- CASS-TL3 SYSTEM POSTS --
5	33953G	CASS-TL3 POST
0	33973G	CASS-TL3 SPLICE POST
8	5700B	CASS-TL3 CABLE SPACER - BLACK
2	5702B	CASS-TL3 CABLE SPACER - WHITE
5	5707T	CASS-TL POST STRAP
5	5708B	CASS-TL SLEEVE COVER
		-- CASS-TL3 SYSTEM CABLES --
3	5633G	CASS SPLICE ASSEMBLY
6	5758G	CABLE - FIELD SPLICE SECTION - 125'-0"

SHOP DRAWING PART 1



Sta. 91+93.50 – Sta. 94+05.50

OAD – WBL)



~ Sta. 91+93.50 – Sta. 94+05.50

OAD – WBL)

	CASS TOOLS	
REQ'D	PART No.	DESCRIPTION
1	5709B	CASS – THERMOMETER – SEARS
1	5850B	CABLE PULLING TOOL – KLEIN
1	5878B	TENSION METER – DILLON QUICK CHECK

NOTES:

1: USE THIS DRAWING IN CONJUNCTION WITH THE PROJECT PLANS AND THE CASS-TL3 STANDARD DRAWING SS730 (LATEST REVISION).
2: USE CASS-TL3 SPLICE POST (33973G) WHERE TURNBUCKLE (5826G) INTERFERES WITH POST.
3: USE (2) REFLECTIVE SPACERS EVERY FIFTH POST (100 FT) IN LIEU OF BLACK SPACER (5700B).

REV.	CHK'D.	BY	DATE	REMARKS
1		E.A.S.	12/11/06	RELEASE FOR FABRICATION

3,680 LF CASS-TL3 CABLE SAFETY SYSTEM WITH (20) CASS CABLE TERMINALS (CCT)

CITY OF THE COLONY
CABLE GUARDRAIL – LEBANON ROAD
DENTON COUNTY
TEXAS

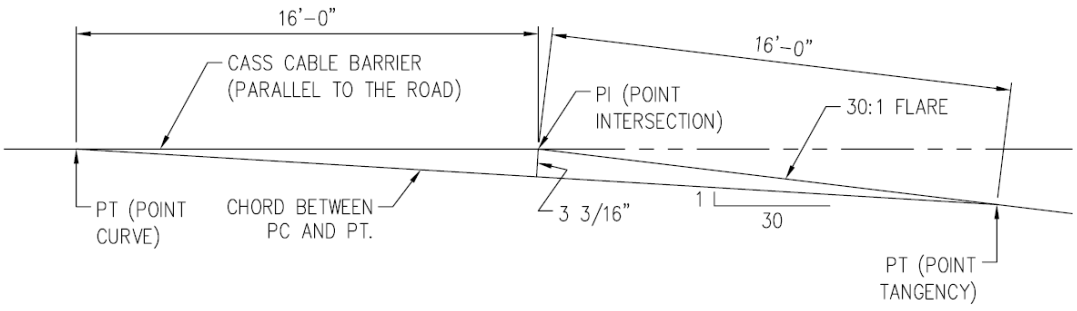
DRAWN: E.A.S.
CHECKED:
APPROVED:
DATE: Tue, Mar 06, 2007
ENG. FILE No. SHOP-DRAWING
SHEET No. D01 of 10
DRAWING NUMBER: 1072117
REV. 1

CUSTOMER: VANN/ELLI INC. P.O. No. ---

TRINITY HIGHWAY PRODUCTS, LLC
2525 STEMMONS FREEWAY, DALLAS, TX 75358

SHOP DRAWING PART 2

CABLE FLARE INSTALLATIONS
30:1 FLARE



ESTABLISH THE POINT OF CURVE (PC) AND THE POINT OF TANGENCY (PT).

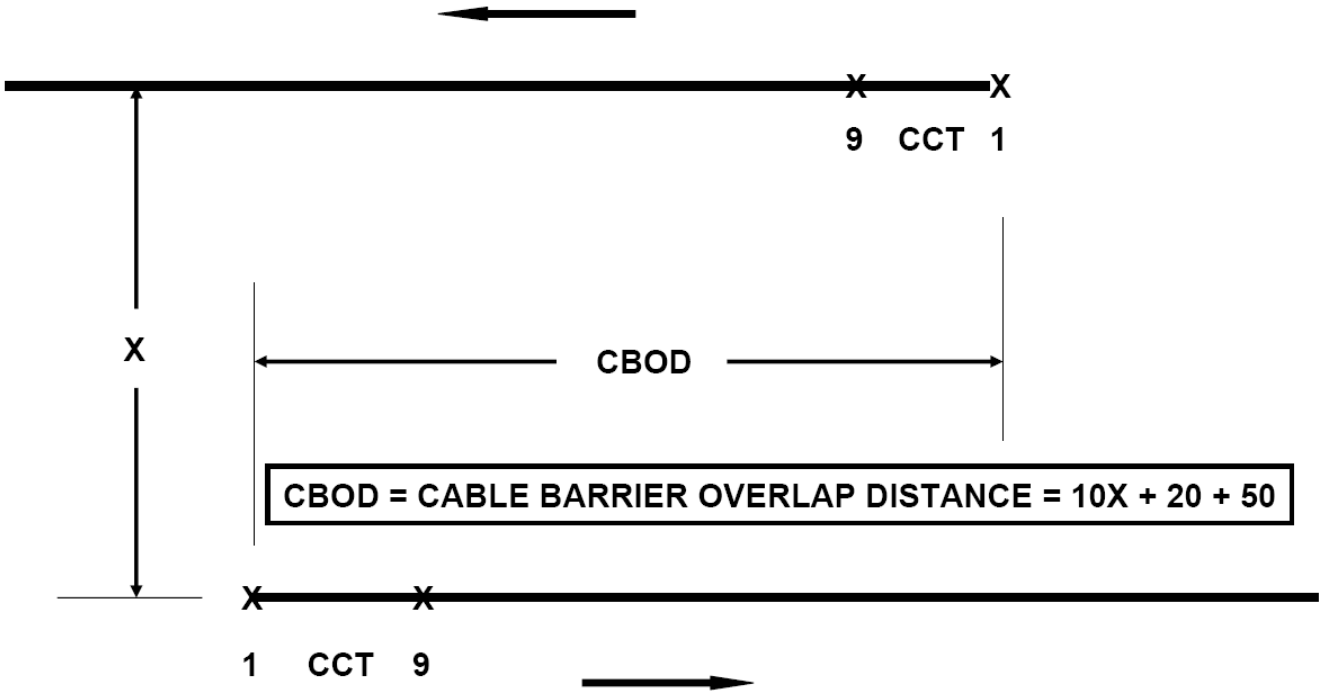
THE POST SPACING BETWEEN THE PC AND PT SHOULD BE A CONTINUATION OF THE POST SPACING ALONG THE ALIGNMENT PARALLEL TO THE ROAD.

THE POSTS SHALL BE INSTALLED SO THEY WILL ALWAYS BE BETWEEN THE TANGENT LINES AND THE CORD LINE BETWEEN THE PC AND PT.

THEY SHALL BE INSTALLED SO THAT THEY WILL FORM A SMOOTH CURVE BETWEEN THE PC AND PT. THIS CURVE CAN START AT THE FIRST POST BEFORE THE PC AND STOP AT THE FIRST POST PAST THE PT.

9/22/2004 1:24:09 PM, By: Elzard A. Sikkema

POST LAYOUT FOR CASS CABLE BARRIER 30:1 FLARE	GALV. SPEC.	–
	SHIPPING WT.	–
	DRWN. E.A.S.	09-22-04
	CHK. D.G.	09-22-04
TRINITY INDUSTRIES, INC.	FLARE 30:1	



CABLE BARRIER OVERLAP

CABLE BARRIER OVERLAP

Use the cable barrier overlap distance calculated by the use of the CBOD formula.

If the Runout Length used for the LON calculations is less than the CBOD value, use the Runout Length.

If the Runout Length is greater than 370 feet, use 370 feet.

CABLE BARRIER OVERLAP

2525 Stemmons Freeway
Dallas, Texas 75207
888-323-6374 (USA only)
214-589-8140 (Outside USA)
www.energyabsorption.com
www.highwayguardrail.com