High Tension Cable Guardrail

Design Manual
Chapter 8
Roadside Safety
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High tension cable guardrail is a flexible barrier system that consists of tensioned steel cables held at varying heights by weak steel posts. The posts are installed in sleeves within concrete foundations, which eases post replacement. Tension in the cables is maintained by anchors at each end of the installation.

High tension cable guardrail is most often used to reduce cross-median crashes and is also the preferred method of shielding median bridge piers. It can also be used to protect other types of objects, as long as adequate distance is provided from the face of the object to the installation line to account for deflection of the cable system.

For installations on level ground, a minimum of 10 feet (12 feet preferred) should be provided from the face of the object to the installation line of the cable. If a minimum of 10 feet isn't available, reduced post spacing can be used. Contact the Roadside Safety Engineer.

High tension cable guardrail can be placed on slopes provided they are 4:1 or flatter. If it is being placed on a 6:1 or steeper slope to protect an object, it should be placed 12 feet (14 feet preferred) from the face of the object to provide a little extra margin of safety to account for the slope. If a minimum of 12 feet isn't available, reduced post spacing can be used to reduce deflection. Contact the Roadside Safety Engineer.

High tension cable guardrail example

Placing high tension cable guardrail on slopes involves some limitations:

- On slopes 6:1 or flatter, the high tension cable guardrail can be located any distance from the foreslope breakover, see Figure 1. However, it cannot be placed any closer than 8 feet from the breakover at the bottom of a ditch, see Figure 1.

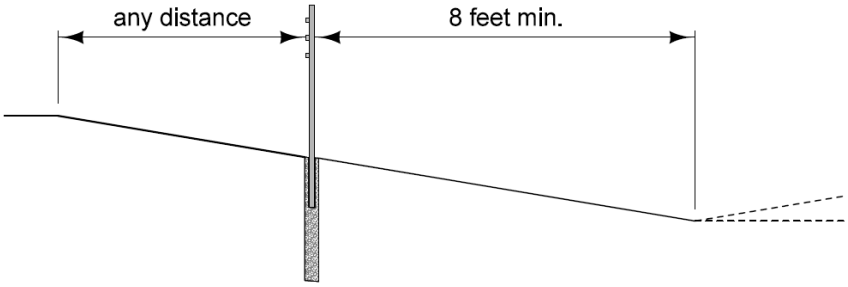


Figure 1: High tension cable guardrail placed on slopes 6:1 or flatter.

- On slopes of 4:1 up to (but less than) 6:1, the high tension cable guardrail must be located no more than 4 feet, or no less than 20 feet, from the foreslope breakover, see Figure 2. It should be placed no closer than 8 feet from the breakover at the bottom of a ditch, see Figure 2.

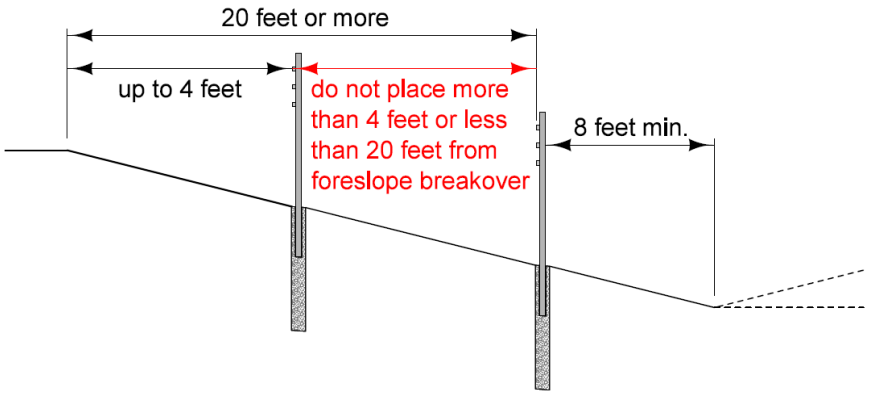


Figure 2: High tension cable guardrail placed on slopes 4:1 to less than 6:1.

A common situation that arises is the need to place high tension cable adjacent to steep slopes (to as steep as 2:1). Manufacturers of the high tension cable guardrail systems approved by the Iowa DOT recommend a minimum of 1 foot (2 feet preferred) between the back of post and the breakover, see Figure 3.

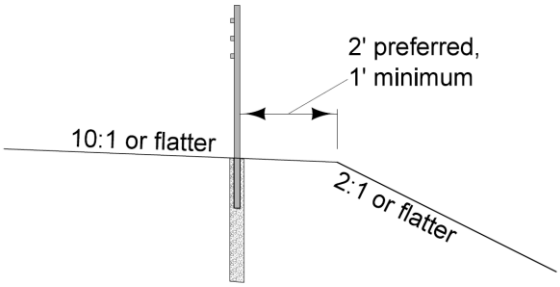


Figure 3: High tension cable guardrail placed adjacent to steep slopes.

High tension cable guardrail can be placed behind a curb provided the curb is no taller than 4 inches. Avoid placing in the area between 1.5 and 8 feet behind the curb (see Figure 4).

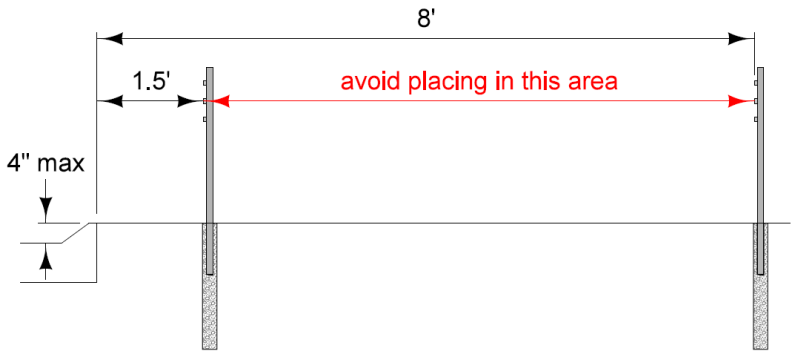


Figure 4: High tension cable guardrail placed behind a curb.

If high tension cable guardrail needs to be flared, it should be flared at a rate of 50:1.

Design Process for Protecting Roadside Objects (One Way Traffic)

The process for laying out the BA-351 high tension cable guardrail for one way traffic involves five steps:

1. **Select the offset from the edge of pavement (D_O).**

   Normally, the high tension cable installation line is placed 12 feet in front of the object. This offset can be greater, but it should not be less than 10 feet. If the object is within a narrow median that does not accommodate this design, or if the object is located close enough to the edge of

traveled way that the installation line encroaches on the shoulder, consult the Roadside Safety Engineer for assistance.

2. **Determine the vehicle departure path.**

   Determine the vehicle departure path as described in Section 8B-6.

3. **Calculate the approach cable length (C_A).**

   Measure the distance between the approach end of the object and the point where the installation line crosses the departure path. Round this measurement up to the next 10 foot increment. Use this value as the approach cable length.

4. **Determine the object cable length (C_O).**

   Measure the length of the object along centerline. Round this measurement up to the next 10 foot increment. Use this value as the object cable length.

5. **Calculate the protection length.**

   Add the approach cable length to the object cable length to determine the protection length (Protection Length = $C_A + C_O$). This is the bid quantity that will be entered in the plans.

The example below demonstrates.

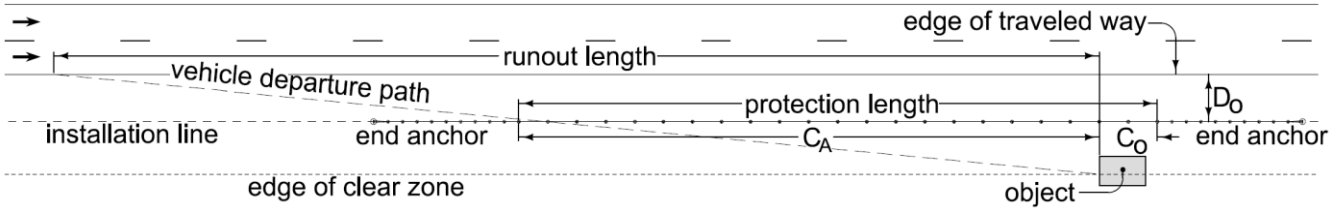
D_o is 16 feet.

Clear zone is 34 feet.

Runout length is 360 feet.

The length of the object is 16 feet measured along the centerline. The back of the object is beyond the clear zone, so the object is protected to the clear zone.

The figure below shows the set up:



The vehicle departure path crosses the installation line 191 feet upstream of the object. Rounding this up to the next 10 foot increment gives a C_A of 200 feet.

The length of the object (16 feet) is rounded up to the next 10 foot increment, so C_O is 20 feet.

The protection length is $C_A + C_O = 200 + 20 = 220$ feet.

Design Process for Protecting Roadside Objects (Two Way Traffic)

The process for laying out the BA-351 high tension cable guardrail for two way traffic involves six steps:

1. **Select the offset from the edge of pavement (D_O).**

   The guidance given for one way traffic applies.

2. **Determine the vehicle departure path for the adjacent and opposing traffic.**

   Determine the vehicle departure paths as described in Section 8B-6.

3. **Calculate the approach cable length (C_A).**

   Measure the distance between the approach end of the object and the point where the installation line crosses the departure path for the adjacent traffic. Round this measurement up to the next 10 foot increment. Use this value as the approach cable length.

4. **Determine the object cable length (C_O).**

   Measure the length of the object along centerline. Round this measurement up to the next 10 foot increment. Use this value as the object cable length.

5. **Calculate the trailing cable length (C_T).**

   Measure the distance between the trailing end of the object and the point where the installation line crosses the departure path for the opposing traffic. Round this measurement up to the next 10 foot increment. Use this value as the trailing cable length.

6. **Calculate the protection length.**

   Add the approach cable length, the object cable length, and the trailing cable length to determine the protection length (Protection Length = $C_A + C_O + C_T$). This is the bid quantity that will be entered in the plans.

The example below demonstrates.

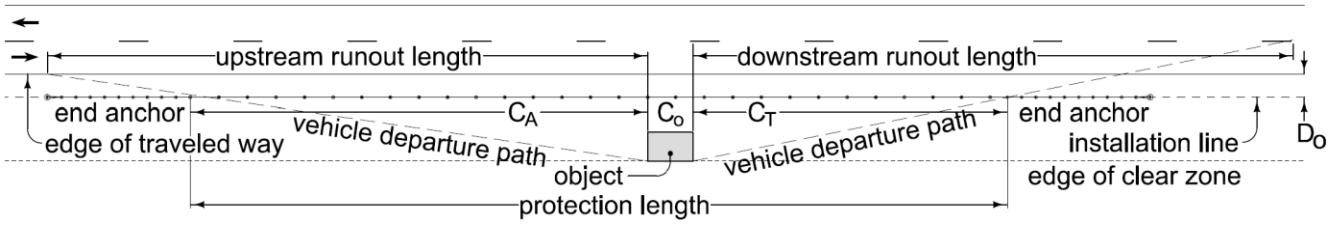
D_o is 8 feet.

Clear zone is 30 feet.

Runout length is 210 feet.

The length of the object is 16 feet measured along the centerline. The back of the object is at the clear zone.

The figure below shows the set up:



The vehicle departure path crosses the installation line 154 feet upstream of the object. Rounding this up to the next 10 foot increment gives a C_A of 160 feet. The vehicle departure path for opposing traffic crosses the installation line 110 feet downstream of the object. This gives a C_T of 110 feet.

The length of the object is 16 feet, so C_o is 20 feet.

The protection length is $C_A + C_O + C_T = 160 + 20 + 110 = 290$ feet.

End Anchors

Every installation must have end anchors. These are added at each end of the installation, but the lengths of the anchors are not included in the protection length. Anchor lengths among the approved manufacturers vary from approximately 30 feet to 50 feet. Since it is unknown which system will be installed, consider 50 feet as the minimum length needed to install any end anchor.

Although end anchors can be placed up to a mile or more apart, this is undesirable since very long runs of cable are more difficult to keep tensioned and will have a higher deflection. Long runs also increase exposure if there is damage to the run resulting in the cable losing tension. Runs should be kept to less than 3000 feet of cable. If a run exceeds 3,000 feet, additional end anchorages should be added.

High Tension Cable Guardrail in Curves

For High Tension Cable Guardrail installed in a curve with a radius of less than 650 feet, contact the Roadside Safety Engineer. Minimum curve radius allowed varies from manufacturer to manufacturer.

High Tension Cable to Steel Beam Guardrail Connection

Unlike steel beam guardrail, high tension cable guardrail cannot be anchored to a rigid object like a concrete barrier or a bridge rail end section. Instead, a crossover from high tension cable to steel beam guardrail is required. This is done using the BA-206, which in turn is connected to a tangent section of W-beam, see Figure 5 below.

The high tension cable to steel beam guardrail connection requires an end terminal with a 4 foot flare. Use BA-206. A minimum of 25 feet of tangent W-beam is required downstream of the BA-206 for the special anchor section required to make the high tension cable to steel beam guardrail connection.

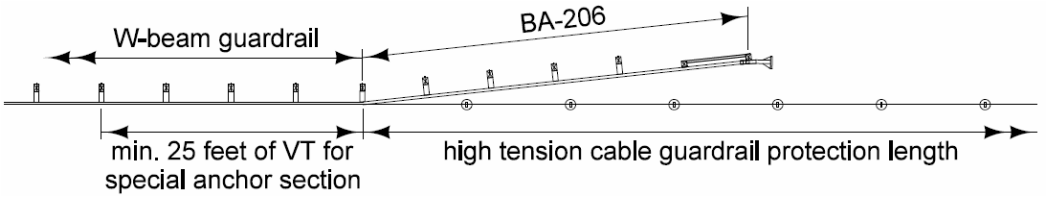


Figure 5: High Tension Cable Guardrail to Steel Beam Guardrail connection.

Since each high tension cable guardrail manufacturer has their own method of attaching the cables to the guardrail, no details are available for the actual attachment.

The W-beam rail should be connected to a rigid object such as a bridge rail or concrete barrier using BA-201. BA-203 should not be used to anchor the W-beam rail. Should the need arise to anchor W-beam rail using BA-203, contact the Roadside Safety Engineer.

For a bid item, use **2505-4020580 GUARDRAIL, SPECIAL ANCHOR SECTION**. This item is bid as EACH and takes the place of one High Tension Cable Guardrail End Anchor. The bid item covers a short section of high tension cable guardrail that ties into the steel beam guardrail. It does not cover any part of the steel beam guardrail installation. The "protection length" for the cable guardrail will end at the point where the BA-206 starts its flare.

The following is included in Project Scheduling System (PSS) as a default estimate reference note:

> This contract item covers the permanent attachment of high tension cable guardrail to steel beam guardrail at the locations shown in the contract documents. Provide a connection meeting the high tension cable guardrail manufacturer's specifications.
>
> This item includes the following: Any additional lengths of cable required, attachment hardware, special steel beam guardrail sections, modifications to any existing steel beam guardrail sections, and any additional labor, equipment, or materials necessary to provide for a complete connection assembly.
>
> The Engineer will count the number of Guardrail, Special Anchor Sections.
>
> Payment will be contract unit price for each Guardrail, Special Anchor Section properly installed.

Spare Parts Kits

Contact the District to determine whether spare parts kits are desired for the proposed installation. The local maintenance garage may already have sufficient inventory on hand for repairs.

Plan Preparation

For most projects, showing high tension cable guardrail installations in the plans should be very straightforward.

- Reference BA-351 and EW-302 (for grading in the median, if applicable).

- Show the installation locations on the plan & profile sheets. Use the HTCableRail line style to draw installations for plan sheets. For more complicated situations, individual detail sheets may be necessary. Contact the Methods Section for guidance.
- Use tabulation 108-9A to identify the specifics of the installation.

The payment length for high tension cable guardrail equals the protection length. The lengths of end anchors are not measured for payment; instead, they are counted as “each” items.

Associated bid items are:

- **2505-6000111 HIGH TENSION CABLE GUARDRAIL**
- **2505-6000121 HIGH TENSION CABLE GUARDRAIL, END ANCHOR**
- **2505-6000131 HIGH TENSION CABLE GUARDRAIL, SPARE PARTS KIT**

Chronology of Changes to Design Manual Section:

008C-003 High Tension Cable Guardrail

11/12/2020	Revised Updates throughout the section.
2/18/2020	Revised Added in material from 8B-5 that is better suited to this section. Noted to contact Roadside Safety Engineer for installations in curves with radii less than 650 feet. Noted BA-203 is not to be used for anchoring a W-beam to cable crossover without contacting the Roadside Safety Engineer.
4/29/2019	Revised Revised Figure 5 to more closely match end treatment being installed.
3/31/2016	Revised Modified Figure 1 and first two bullets on page 1. According to NCHRP Report 711, high tension cable can be placed at any distance on 6:1 or flatter slopes. Eliminated third bullet on page 1. All approved systems are TL-4, so no Estimate Reference Note is needed. Added information and Figure 5 to high tension cable to W-beam connection discussion.
8/21/2015	NEW New