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DEPARTMENT OF TRANSPORTATION

SHOULDER AND GUIDE RAIL CONDITION SURVEY FIELD MANUAL PUBLICATION 33

APRIL 2020

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SHOULDER AND GUIDE RAIL
CONDITION SURVEY
FIELD MANUAL

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Introduction

This manual is for use with the Pennsylvania Department of Transportation's Shoulder Condition Survey and Guide Rail Inventory and Condition Survey. The purpose of these surveys is to provide location-specific condition data on the shoulder and guide rail and median barrier systems along Pennsylvania's highways.

The data collected is used for the following purposes:

1. To provide a uniform statewide condition evaluation that would improve decision-making.

2. To provide management with the information and tools to monitor the condition of the network, assess future needs, establish county condition rankings and optimize investments.

3. To provide condition information to fulfill the requirements of Act 68 (1980), that requires the allocating of maintenance funds to the individual counties based on needs.

4. To provide information for monitoring the performance of various guide rail and median barrier designs, rehabilitation and maintenance techniques.

5. To provide information for identifying candidate projects for maintenance and betterment programs.

Survey Techniques and Procedures

General:

The guide rail survey is to be both an inventory of the barrier along Pennsylvania's highways and a survey of its conditions. The guide rail survey includes all systems along the roadside and in the median on state routes. The intention is to conduct this survey in conjunction with the shoulder condition survey. Each segment will be driven slowly along the shoulder, where possible, by a two-person team consisting of a Driver and a Guide Rail and Shoulder Evaluator. The duties of the driver are to safely drive the vehicle on the shoulder or roadway, as necessary, during the survey, and to assist the evaluator in conducting the survey. As the team is proceeding down the highway, the evaluator will note the location of the beginning and end of each guide rail and median barrier section, the type of guide rail, barrier and end treatment, and the various types, severities and extents of conditions exhibited by the guide rail and barrier. At the same time, the evaluator will note the condition of the shoulder. The survey team will complete the appropriate portions of the electronic Condition Survey Input Form – Guide Rail at the end of each guide rail and barrier system, and a separate form for Shoulder Conditions at the end of each Segment. One survey pass will be sufficient to adequately note all shoulder, guide rail and barrier systems and conditions for the large majority of segments. It may, on occasion, be necessary to re-drive a segment to identify all shoulder, guide rail or barrier and their conditions.

The physical characteristics of the roadway (i.e., lack of shoulder) or extremely high traffic volumes in some areas may require deviations from recommended survey techniques to assure safe conduct of the survey. The team may find it necessary to survey these segments entirely on foot.

The electronic forms to be used in the survey will be preloaded to the STAMPP application on laptop or tablet PC with the segment identification near the top of the form. New forms can be generated for segments that require additional survey forms because of new or previously misidentified guide rail or barrier sections or misidentified shoulder information. There may be discrepancies in the preloaded segment identification information, such as guide rail or barrier length indicated vs. that measured with the Distance Measuring Instrument (DMI). The evaluator should provide a note explaining the discrepancy in the "Remarks" section of the survey form.

Many instances will be encountered in the performance of the Shoulder and Guide Rail Survey that do not exactly conform to the general descriptions or instructions in this manual. *Some of these are listed below, along with recommended procedures.* For other unusual circumstances, judgment should be exercised and a note added to the survey form.

Divided Highways:

Right and left shoulders are surveyed on all segments. Right is "right" and left is "left" on divided highways in the primary direction, the direction of increasing Segment – North or East. Right becomes "left" and left becomes "right" on divided highways in the secondary direction – South or West.

Inventory single median barrier, on divided highways with a narrow median, only once. This median barrier, when used in both directions, will be recorded as "c" for center in the primary direction.

Structures:

The Guide Rail Survey will include guide rail and barrier across structures that are less than 8 ft. in length. For structures that are 8 ft. or longer, structure-mounted guide rail and median barrier on the deck is included in the Bridge Management System (BMS) and is not to be duplicated through the Guide Rail Survey. The guide rail leading up to the bridge parapet, no matter what the length, must be surveyed with the Guide Rail Survey. Guide rail that protects motorists from abutments and piers at underpasses is not in BMS and must be inventoried and surveyed through the Guide Rail Survey.

Include shoulders of bridge approach slabs in the survey. However, do not survey shoulder conditions on bridges nor count the bridge length when determining extents.

Ramps:

Generally, ramps are not part of the condition survey. Do not survey guide rail and barrier along ramps as part of the Guide Rail Survey. Do not collect shoulder conditions on the ramp acceleration and deceleration lanes.

Shoulders:

There are two widths defined in RMS for each shoulder. The Total Width refers to the predominant graded width, i.e., from the edge of pavement to the face of the guide rail or break point of the slope. The Paved Width refers to the predominant width of the paved portion adjacent to the edge of pavement. Total Width and Paved Width should be equal when a shoulder is paved full width. Paved portions not adjacent to the edge of pavement, such as paved gutter beyond the unpaved shoulder, should be ignored.

Curbed Segments:

The shoulder form should be completed as follows for those segments that are predominantly, more than 50%, curbed on one or both sides:

- Mark Average Total Width and Average Paved Width as “0”
- Mark type as “Curb”
- Evaluate “Lane/Shoulder Separation” at the pavement/curb joint
- Mark all other distresses as “None”

Parking lanes should always be evaluated as part of the pavement.

Curb Gutter:

The shoulder form should be completed as follows for those segments that are predominantly, more than 50%, curb gutter on one or both sides:

Gutter is less than 1 foot wide:

- **Mark “Curb” only**
- Evaluate “Lane/Shoulder Separation” at the pavement/curb joint
- Mark all other distresses as “None”

Gutter is between 1 and 3 feet wide:

- **Mark Average Total Width as width of gutter**
- **Mark Average Paved Width as width of gutter**
  NOTE: Average Total Width must equal Average Paved Width
- Mark type as “Curb/Gutter”
- Evaluate “Lane/Shoulder Separation” at the pavement/gutter joint
- Mark all other distresses as “None”

Gutter is greater than 3 feet wide:

- **Do not survey. See the District STAMPP Coordinator**

Duties and Responsibilities

Safety First:

First and foremost of the Survey Team's responsibilities is **SAFETY**! No matter how important the information obtained is, it is not worth more than the health or life of anyone. In order to conduct a safe survey the Survey Team must be alert for potential problems. The Driver and the Evaluator must be alert at all times and utilize defensive driving skills.

The Driver:

The driver's primary responsibility is to operate the survey vehicle in a safe, courteous manner in accordance with the laws of the Commonwealth. The driver will operate the vehicle at a convenient rate of speed for performing the survey from the beginning of the segment to the end, noting conditions wherever possible. It is recommended that the Driver note the shoulder conditions when there is guide rail present for the Evaluator to survey. The Driver will locate a safe place to stop at the end of the guide rail or barrier section, or the end of the segment for the shoulder survey, and park while the Evaluator completes the Survey Form.

The Driver is responsible for determining the team's location using fixed reference points (intersections, bridges, etc.), the DMI and Straight Line Diagrams (SLD). The driver shall keep records to assure that all segments are covered as planned and determine the team's routing to minimize non-productive travel.

Evaluator:

The Guide Rail Evaluator should be seated in the RIGHT FRONT SEAT to have an un-obstructed view of the guide rail and median barrier. The Evaluator shall observe the location, type and condition of the guide rail and median barrier. The Evaluator shall note shoulder type, widths and conditions with assistance from the Driver.

A separate form shall be used for each segment for both guide rail and shoulders. The heading information should be preloaded for each segment as discussed previously. The Evaluator is responsible for completion of any missing information, including date and observer numbers.

Each guide rail form provides space for one guide rail or barrier installation. Where no installation exists, the Evaluator should check "**No Guide Rail**" on the form. New forms can be generated if there are two or more guide rail or barrier installations within a segment. Use new forms if more forms are needed than are preloaded.

When the Driver stops at the end of the guide rail or barrier section or at the end of the segment for shoulders, the Evaluator shall complete the appropriate sections of the Survey Form, discussing the ratings with the Driver. The completed form should be a consensus of the Driver and Evaluator where possible. The Evaluator should then save the completed form and the team proceeds to the next segment or guide rail or barrier section.

The Evaluator should keep a list of obvious discrepancies in the SLD or County maps. Report these discrepancies to the District RMS Coordinator.

Serious hazards to the motoring public should be reported to the RMS Coordinator as soon as possible. The RMS Coordinator will contact the appropriate District unit to address the issue. If the RMS Coordinator cannot be reached, any hazard or issue that requires immediate corrective action should be reported to the County Maintenance Manager.

Questions From The Public:

The survey team should answer questions from the public honestly and diplomatically to maintain good public relations. Inform the citizen that a condition survey is being conducted to better enable the Department to maintain the shoulder and guide rail. Politely direct any specific complaints to the Assistant District Engineer for Maintenance or the County Maintenance Manager. Keep the appropriate phone numbers on hand for these occasions.

Equipment

Following is a list of equipment for the proper performance of the Guide Rail and Shoulder Survey:

1. Compact state car equipped with:
   a. Digital distance measuring instrument (DMI) which accurately determines the distance driven from a given point;
   b. Amber flashing warning beacon;
   c. Survey sign

2. County maps (paper or digital)

3. Straight Line Diagrams (SLD), paper or digital

4. Shoulder and Guide Rail Condition Survey Field Manual

5. Clipboard

6. STAMPP application on tablet or laptop PC with eSTAMPP forms preloaded

7. Six-foot rule

8. Pens, pencils, and tablet paper for taking notes

9. Hard hats and safety vests

10. File folders

11. 100-foot tape

12. String line

Extent Estimation

Shoulder:

This section contains information that will help in estimating the extent of the shoulder conditions.

A 1,500 feet long segment:

1%	-	15 ft
5%	-	75 ft
10%	-	150 ft
15%	-	225 ft
30%	-	450 ft

A 2,500 feet long segment:

1%	-	25 ft
5%	-	125 ft
10%	-	250 ft
15%	-	375 ft
30%	-	750 ft

A ½ mile long (2,640 ft) segment:

1%	-	26.4 ft
5%	-	132 ft
10%	-	264 ft
15%	-	396 ft
30%	-	792 ft

A 3,000 feet long segment:

1%	-	30 ft
5%	-	150 ft
10%	-	300 ft
15%	-	450 ft
30%	-	900 ft

Guide Rail and Median Barrier:

This section contains information to assist in estimating the extent of certain guide rail/median barrier conditions.

Cable Sag, Deterioration, Hardware and Height – These distresses are measured in terms of length. Therefore, the percentage can be expressed as simply the length of each condition divided by the system length in the segment.

Post Deflection – Count the number of posts deflected and then determine the predominant post spacing from the chart below to calculate the total number of posts in the section of guide rail/median barrier.

System Type	Post Spacing	Panel Length
A & B	16’0” or 10’0”	N/A
C	6’3”, 3’1-1/2” or 1’6-3/4”	12’6”
D	6’3”, 3’1-1/2” or 1’6-3/4”	12’6”
E	6’3”, 3’1-1/2” or 1’6-3/4”	12’6”
F	12’6”, 6’3” or 3’1-1/2”	12’6”
G	6’3”, 3’1-1/2” or 1’6-3/4”	12’6”
H	12’6” 6’3” or 3’1-1/2”,	12’6”
I	6’0” or 4’0”	18’
L	20’0”, 16’5”, 10’0” or 6’6”	N/A
M	10’0” maximum	N/A
N	10’0” maximum	N/A
P	10’0” maximum	N/A
Q	10’0” maximum	N/A
R	6’3”, 3’1-1/2” or 1’6-3/4”	12’6”
S	6’3”	12’6”
T	12’6”	12’6”
U	Short transition, count actual number of posts	

$$\frac{\textbf{\# posts deflected}}{\textbf{\#posts}} \times 100 = \textbf{\% posts deflected}$$

NOTE: Calculate for each severity level.

Cable Sag – Count the length of cable in each severity level. Use the above chart for post spacing to assist in determining the extent.

Completion of Condition Survey Input Form

Identification Section:

This section will be preloaded to the STAMPP application on tablet or laptop PC. The information in this section should be reviewed to ensure that information is correct.

Segment Identifier: There are three fields for the segment identifier, in the same format as the Department's other databases, consisting of:

County Name and Number
State Route
Segment No.

Segment Length: The length of the segment in feet.

Direction: The direction of the portion of the roadway being evaluated using the following coding:

For 2 or 3 lane sections, with one form for both directions (both directions are in the same segment), use "B."
For 4 or more lanes, use N, S, E, or W for the direction of survey travel.

Common Street Name: Street name used by general public.

Beginning Description: Narrative description of the segment beginning point.

Ending Description: Narrative description of the segment ending point.

Observers: the survey team code numbers. Observer 1 is the Evaluator; Observer 2 is the Driver. Observer 3 is used if an additional individual is in the vehicle.

Survey Date: The date the team surveys the segment. (Located in the body of the form.)

Evaluation Section:

Shoulders – Complete the appropriate parts of this form depending on the type of shoulder being evaluated. Note the condition by considering the severity level of each condition and the extent of each severity encountered. The input form format generally allows 10 choices, with all combinations of three severity levels and three extents, plus "NONE." This format is abbreviated for a few conditions.

Record shoulder conditions by checking the appropriate button. Check up to two buttons (different severities, same or different extents) for each condition. Note that if "None" is checked, there should be no other checks for that condition. Note also that only one button may be checked in a severity level. If a check of only one button, other than "None," adequately describes the condition, a second check is not necessary. **If all three severity levels exist in the segment, check only the medium and high severities even if low severity has the greatest extent.**

The Total Width and Paved Width, for both right and left shoulders, will be preloaded on the survey forms as they currently appear in the Roadway Management System (RMS). Check these widths in the field for accuracy. Enter the correct width if there are any discrepancies. Note the predominant shoulder type while surveying the segment using the following descriptions:

None – No shoulder, curb, or curb-gutter are present
Turf – Grass shoulders
Curb – Segment is predominantly curb
Curb-Gutter – Segment is predominantly curb-gutter
Gravel – Shoulder has a gravel surface
Asphalt – Shoulder has an asphalt surface
Concrete – Shoulder is concrete

Evaluate "Slope," "Buildup" and "Drop-off" on all shoulders. Also evaluate "Lane/Shoulder Separation" and "Deterioration" on shoulders with a paved surface (asphalt or concrete).

Make narrative remarks concerning the segment in the space marked "Remarks." Remarks include, but are not limited to, unusual conditions not recorded in the Evaluation Section, hazards noted and reported to the County Maintenance Manager or reasons for not evaluating the segment (i.e., construction, bridge, heavy traffic, etc.).

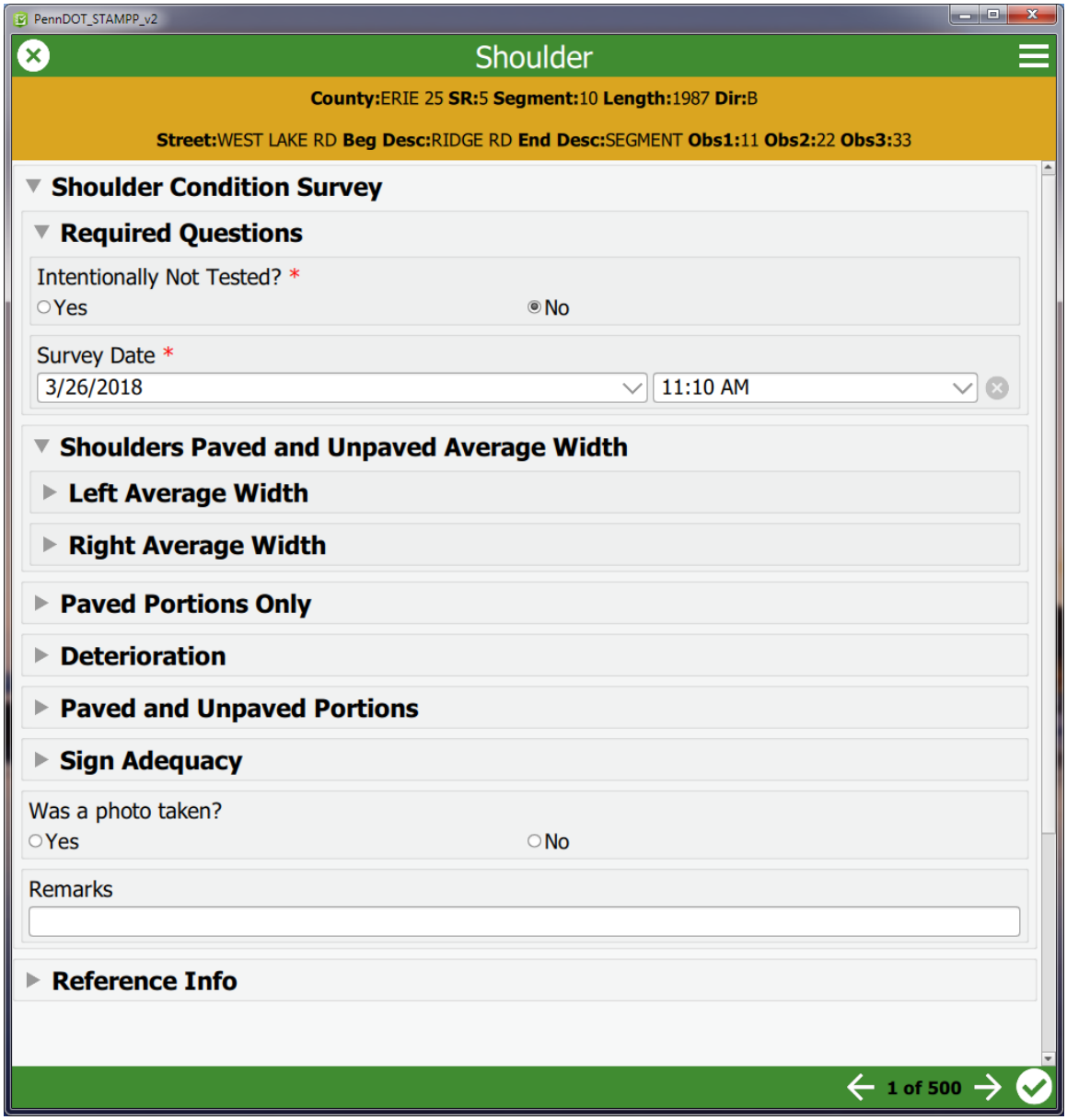
Guide Rail – The guide rail and median barrier survey includes all guide rail and barrier systems along the roadside and in the median on state routes. Barrier systems across bridges less than 8 ft. long will also be included. The barrier systems on bridges 8 ft. or longer are included in the Bridge Management System (BMS) and should not be duplicated.

Each form provides space for one guide rail or barrier installation. Check "**No Guide Rail**" on the form for segments where there are no guide rail or barrier

installations. New forms can be generated when additional forms are needed (not enough preloaded forms). Enter the segment identification information on the new forms.

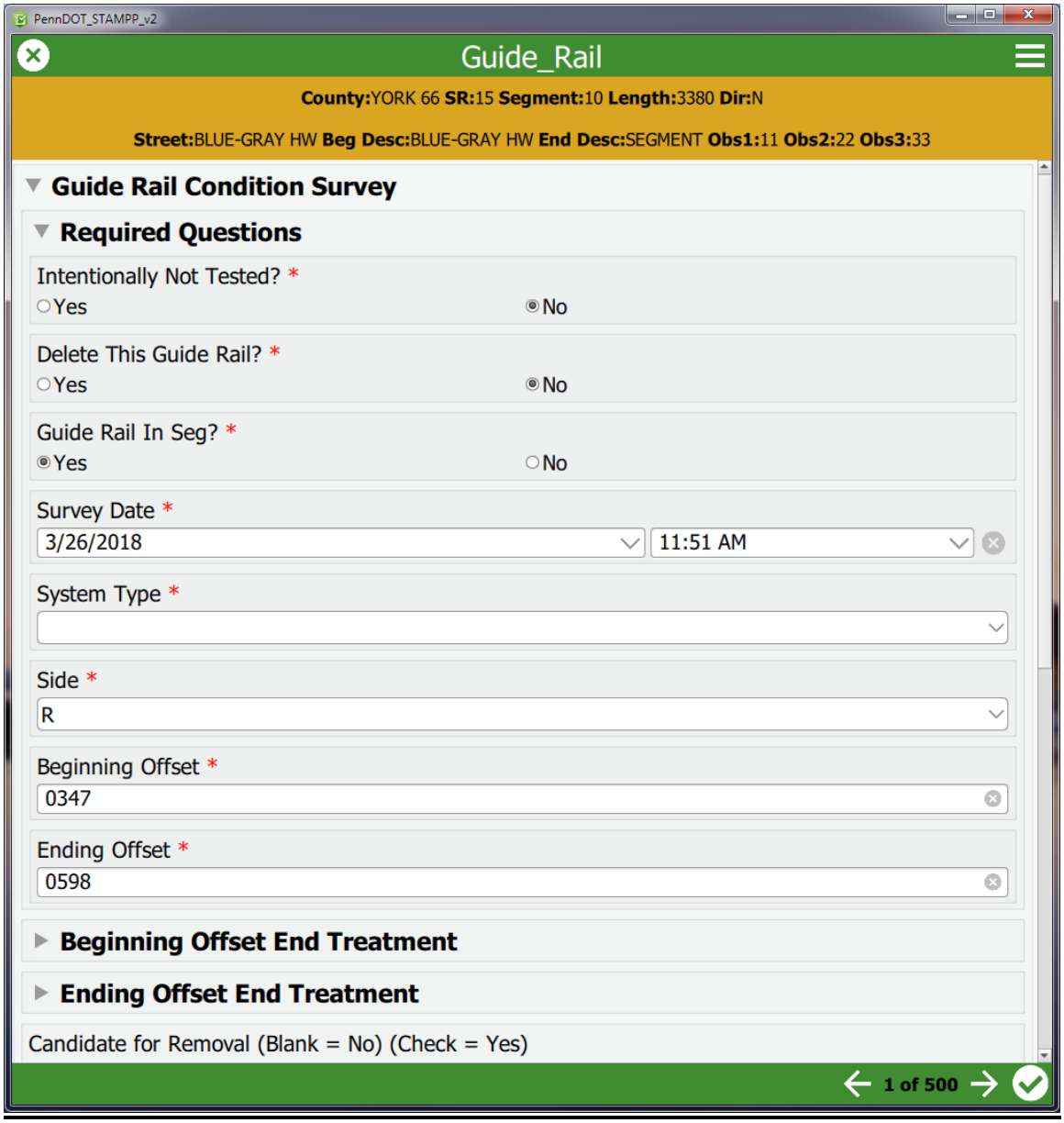
Record guide rail and barrier conditions by checking the appropriate button. Check up to two buttons (different severities, same or different extents) for each condition. Note that if "None" is checked, there should be no other checks for that condition. Note also that only one button may be checked in a severity level. If a check of only one button, other than "None," adequately describes the condition, a second check is not necessary. **If all three severity levels exist in the guide rail or barrier section, check only the medium and high severities even if low severity has the greatest extent.**

Shoulder eSTAMPP Survey Form



(Layout may change based on current version of the STAMPP application)

Guide Rail eSTAMPP Survey Form



(Layout may change based on current version of the STAMPP application)

Definitions

Shoulders:

Shoulder: The area outside the edge of the traveled pavement usually graded to a uniform slope to accommodate vehicular recovery, emergency parking or drainage. Count no shoulder on a segment that has a 4 ft median with guide rail or median barrier.

Paved Shoulder or Paved Portion: A shoulder or portion of a shoulder that has a hard surface. This includes Portland Cement Concrete and Bituminous Concrete (Asphalt) and Bituminous Seal Coat or Surface Treatment.

Unpaved Shoulder or Unpaved Portion: A shoulder or portion of a shoulder graded to a uniform slope but without a hard surface. Includes turf, earth, aggregate stabilized and dust oil.

Left/Right Shoulder: The side on which a shoulder is recorded is **always** determined by looking in the direction of increasing segment direction, regardless of the traffic or survey direction. The median shoulder is the left shoulder on Interstates and other divided highways when headed East or North (the primary directions). The median shoulder is the right shoulder when headed West or South (the secondary directions).

Edge of Pavement: The longitudinal line separating the pavement from the shoulder, ramp acceleration and deceleration lanes, or intersecting roads. Areas of existing widening are included between the edges of pavement, but paved shoulders are not.

Rigid Pavement: A pavement with a jointed Portland Cement Concrete riding surface. Rigid pavement includes Plain Cement Concrete Pavement (PCCP) or Reinforced Cement Concrete Pavement (RCCP). These are 70 series surface types.

CRC Pavement: Continuously Reinforced Concrete, a pavement with a Portland Cement Concrete riding surface with no joints. This is surface type 73.

Bituminous Pavement: A pavement with a bituminous (asphalt) riding surface on any type base. These are 50 and 60 series surface types.

Guide Rail:

Offset: Offset is the distance in linear feet from the beginning of a STAMPP segment, measured parallel to the centerline of the roadway (recorded on the Distance Measuring Instrument installed in the survey vehicle), to the beginning or ending point of a section of guide rail or barrier. The beginning offset section of the survey sheet is for the low offset of the guide rail or barrier string. The ending offset section of the survey sheet is for the high offset of the guide rail or barrier string.

End Treatment: A protective device used to shield errant vehicles from penetration or impalement on the end of a guide rail or barrier system. The end treatment also serves to provide system strength in all cable and weak post w-beam systems. Following is a list of end treatments and the end treatment type code to use on the survey form:

Code	End Treatment
1-BIBS	Buried in Back Slope
2-FLT	FLEAT-350
2-MFLT	MASH Compliant FLEAT
2-BTSS	BEAT-SSCC
2-ET	ET-2000
2-ETPL	ET-Plus with SYTP (Steel Yielding Terminal Post)
2-FLTS	FLEAT-SP
2-BEST	BEST
2-SKT	SKT-350
2-SKTS	SKT-SP
2-MSKT	MASH-SKT
2-SNT	Sentry
2-XTEN	X-Tension
2-MTEN	MAX-Tension, Test Level 2
2-MTN3	MAX-Tension, Test Level 3
2-XLTE	X-LITE
2-YBET	WY-BET
2-SOFT	SoftStop
3-BCT	Breakaway Cable Terminal
3-MELT	Modified Eccentric Loader Terminal
3-SRT	SRT–350
3-ROS	Ross-350
4-CAT	CAT
4-BRK	Brakemaster
4-ADM	ADIEM
4-FLTM	FLEAT-MT
4-TENM	MAX-Tension Median
5-RACT	REACT-350
5-RE60	REACT-350(60”)
5-SCI	SCI100GM
5-SCI7	SCI70GM
5-QUAD	QuadGuard
5-QELI	QuadGuard Elite

Code	End Treatment
5-QDHS	QuadGuard HS
5-QM10	QuadGuard M10
5-QST	Quest
5-TRA	TRACC
5-WTRA	WIDETRACC
5-STRA	SHORTRACC
5-FTRA	FASTRACC
5-TAU	TAU-II
5-TAUM	TAU-M
5-GRT	GREAT
5-HEX	Hex Foam Sandwich
5-XTNU	X-TENuator
6-SAND	Sand Filled Plastic Barrels
M-ARMG	ArmorGuard Gate
M-TDWN	Turned Down, Concrete End Anchor
M-BEND	Blunt End (Fist)
M-2SA	Type 2-S Post Anchorage
M-SPAT	Type 31 Strong Post Anchor Terminal
M-SCON	Sloped Concrete
M-BGAT	Barrier Gate
M-VULC	Vulcan Gate
M-BCON	Bridge Connection
M-OTH	Other
M-CON	Continue

Undamaged End Treatment: An end treatment in good physical condition such that it serves its intended purpose, which is to protect the end of the system or provide system strength.

Damaged End Treatment: An end treatment that is deteriorated or damaged to the extent that it no longer serves its intended purpose. In the case of bridge connections, any treatment that does not consist of a w-beam panel physically attached to the parapet face with a standard terminal section bridge connection or roadside concrete barrier adjacent to and carried across the structure, is considered damaged. **In the case of the ET-Plus (2-ETPL), the survey will be enhanced by the completion of the included ET-Plus End Treatment Inspection Checklist for every ET-Plus installation. The ET-Plus shall be marked as damaged if any items listed on the checklist get marked as "No" from the inspection. If the paper form is used, each District is expected to keep their inspection checklists on file.**

R/L/C: Right/Left/Center. The side on which guide rail or barrier is recorded is **always** determined by looking in the increasing segment direction, regardless of the traffic or survey direction. A single section of guide rail in the median on divided highways, considered median barrier, is recorded with the increasing segment direction.

System Type: This indicates the kind of guide rail or barrier system located within a given segment. There are 20 system types:

Code	System
A	Strong Post Cable
B	Weak Post Cable
C	Strong Post W-Beam With Rub Rail & Offset Bracket
D	Strong Post W-Beam With Offset Bracket, No Rub Rail
E	Strong Post W-Beam, No Offset Bracket, No Rub Rail
F	Weak Post W-Beam
G	Strong Post W-Beam, Double Faced
H	Weak Post W-Beam, Double Faced
I	Weak Post Box Beam
J	Concrete Safety Barrier
K	IBC Barrier
L	Cable Safety System (CASS)
M	Wire Rope Safety Fence (WRSF)
N	SAFENCE Cable Barrier
P	Gibraltar Cable Barrier
Q	NU-CABLE Barrier
R	31” Strong Post W-Beam With Offset Bracket, No Rub Rail
S	31” Strong Post W-Beam, Double Faced
T	32” Weak Post W-Beam
U	Thrie-Beam Bridge Transition
Z	Other

Candidate for Removal: All or a portion of the string of guide rail or barrier may become a candidate for removal if, in the observer’s opinion, it may be more desirable for a vehicle to run over the protected slope or the protected obstruction than to hit the guide rail or barrier. For locations indicated as “candidates for removal,” an individual familiar with guide rail and barrier warrants will conduct a follow-up site inspection to determine whether all or a portion of the existing guide rail or barrier can actually be removed.

Side Dozing: Side dozing will be required at those locations where a ridge of earth has formed at the edge of the shoulder under the guide rail. This ridge serves as a barrier for water run-off from the pavement and shoulder.

PHOTO GUIDE

SHOULDERS

Lane/Shoulder Separation

Description:

This condition is characterized by an open joint between the traffic lane and the paved shoulder that allows infiltration of water into the joint. If curbing exists, then it should be rated according to the width of the joint between the pavement and the curb or curb-gutter.

Possible Cause:

Lane/Shoulder separation is generally caused by outward movement of the shoulder or curb.

Rating Procedures:

None: No severity level is counted if the joint is well sealed to prevent moisture intrusion.

Low: Opening is < 0.25 in wide

Medium: Opening is ≥ 0.25 in & ≤ 1.0 in

High Opening is > 1.0 in

Extent:

Record the length of the segment for each severity having Lane/Shoulder Separation for right and left shoulders separately.

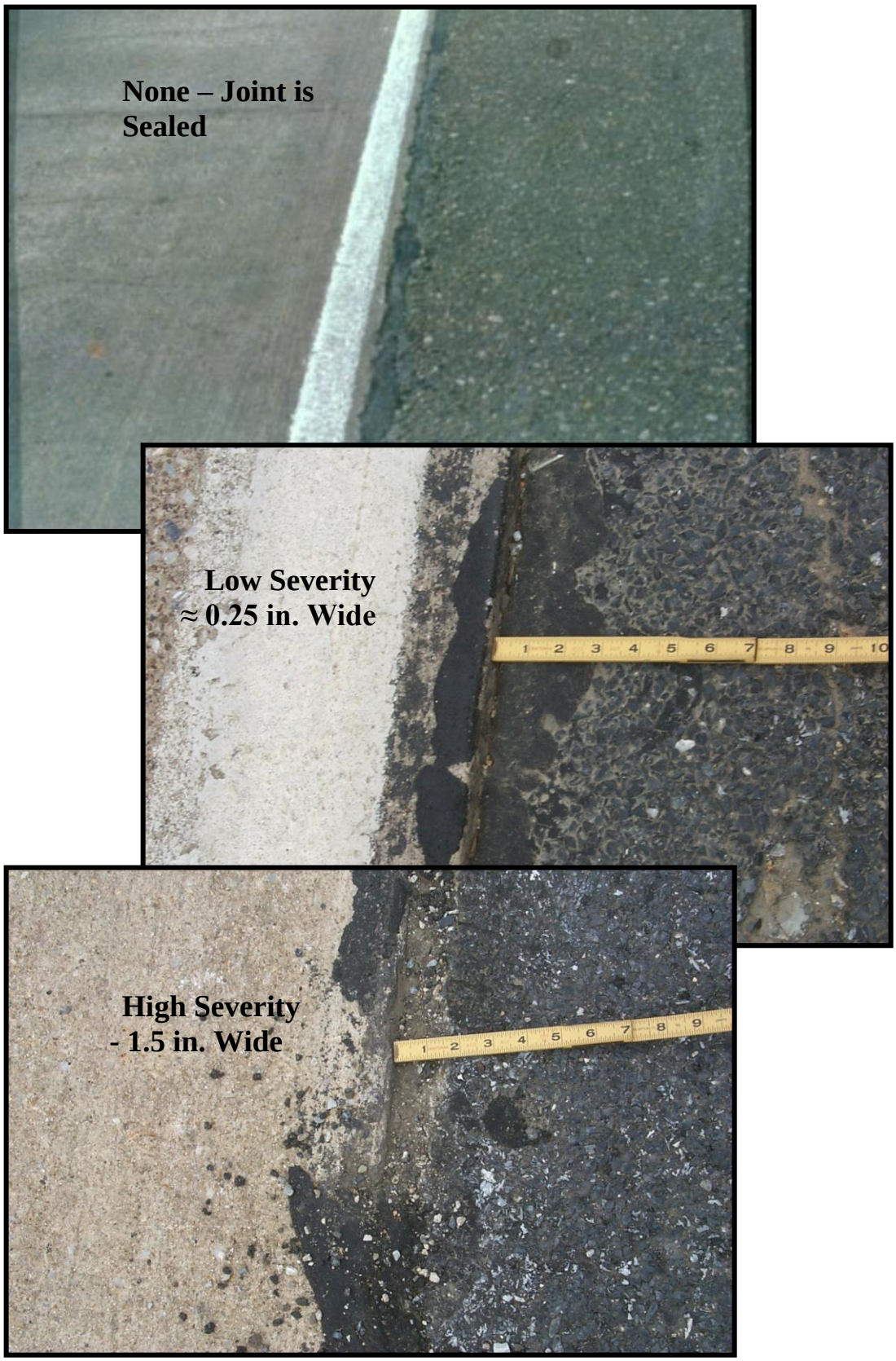
Note:

- Do not consider Lane/Shoulder Separation where the shoulder is deteriorated along the pavement edge and the opening is a result of the deterioration.
- Lane/Shoulder Separation generally occurs on concrete pavements with bituminous shoulders.
- On concrete shoulders, determine whether the joint is sealed. Count the severity level according to the joint width if it is not sealed.

LANE/SHOULDER SEPARATION			NONE	<10%	10-30%	>30%	LENGTH
				7	8	9	>1"
				4	5	6	1/4" - 1"
			0	1	2	3	<1/4"

(Actual form layout will vary)

Lane/Shoulder Separation



Deterioration

Description:

This condition is characterized by surface and/or structural distress in **paved** shoulders only (asphalt and concrete).

Possible Causes:

Deterioration of shoulders is generally caused by the same factors that deteriorate pavements. These factors include weakness in the base or subgrade, shrinkage of the surface due to low temperature at the time of construction, asphalt hardening and oxidation of the asphalt binder.

Rating Procedure:

Shoulder deterioration is collected across the entire shoulder area.

Severity Levels:

None: Shoulder is like new; no distress present

Low: Minor surface raveling or cracking within 3 ft of pavement edge

Medium: Minor surface raveling or cracking over entire shoulder

High: Severe fatigue cracking within 3 ft of pavement edge. Count Deterioration occurring from the outside edge of the shoulder in this severity only when it extends to within 3 ft of the pavement edge.

Extent:

Record the length of the segment for each severity having Deterioration for right and left shoulder separately.

DETERIORATION			NONE	<10%	10-30%	>30%	LENGTH
				7	8	9	HOLES/SEV.CRKNG
				4	5	6	ENT. PAVED WIDTH
			0	1	2	3	MINOR CRACKING

(Actual form layout will vary)

Deterioration

Deficient Slope

Description:

This condition is characterized by paved or unpaved shoulder cross-slope that restricts water runoff from the pavement.

Possible Causes:

Frost heaving, movement of the materials due to traffic loads or collection of debris can cause deficient slope.

Rating Procedure:

Deficient slope is collected along the entire length of both left and right shoulders.

Severity:

None. If water from the pavement cannot drain across the shoulder, then rate the shoulder as having deficient slope.

Extent:

Record the length of the segment for each severity having Deficient Slope for right and left shoulders separately.

SLOPE			NONE	<10%	10-30%	>30%	LENGTH
			0	1	2	3	DOES NOT DRAIN

(Actual form layout will vary)

Deficient Slope
(Typical Sections)

- Note how shoulder elevation is higher than pavement edge thereby preventing the pavement from properly draining across the shoulder.

- Note how the shoulder is rutted next to the pavement edge thereby preventing pavement runoff from properly draining across the shoulder.

Buildup

Description:

This condition is characterized by an accumulation of materials at the outside edge of a paved or unpaved shoulder, including the area beneath existing guide rail and will be recorded in swale areas, ditch areas or fill areas.

Possible Cause:

Buildup is usually caused by the collection of anti-skid and/or other materials, or by the growth of vegetation, at the outside edge of the shoulder.

Rating Procedure:

Buildup is collected along the entire length of both left and right shoulders.

Severity:

None. If water cannot drain off the shoulder, then rate as having buildup.

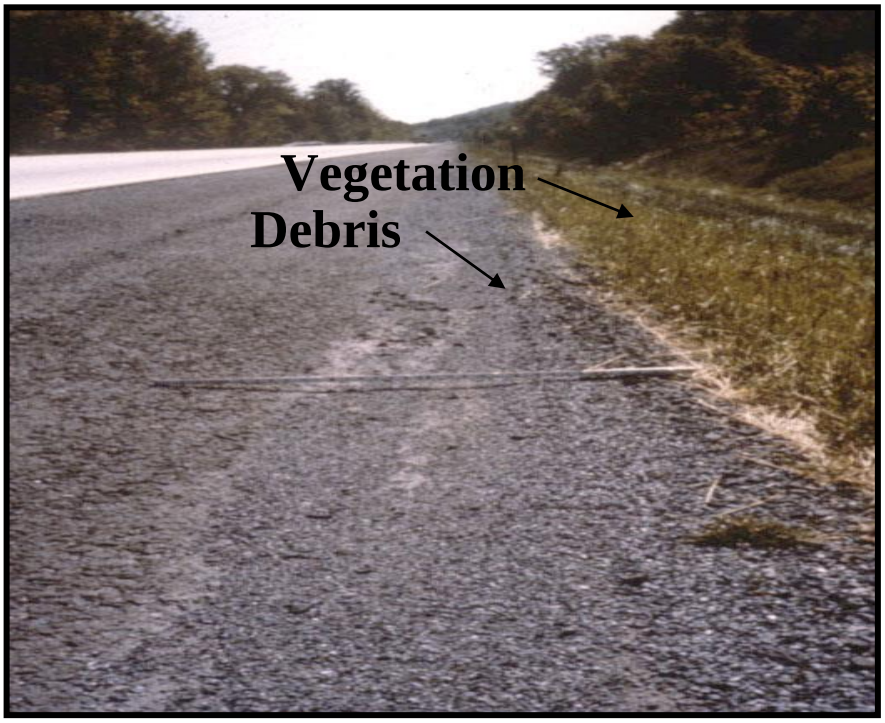
Extent:

Record the length of the segment having Buildup for left and right shoulders separately.

BUILDUP			NONE	<10%	10-30%	>30%	LENGTH
			0	1	2	3	DOES NOT DRAIN

(Actual form layout will vary)

Buildup



Shoulder Drop-Off

Description:

This condition is characterized by the difference in elevation between the traveled surface and the paved or unpaved outside shoulder.

Possible Causes:

Shoulder Drop-off is caused by successive increases in pavement lane thickness (overlays), settlement of the shoulder base materials, or shoulder material loss from vehicles pulling off the pavement onto the shoulder.

Rating Procedure:

Shoulder Drop-off is evaluated along the entire length of both left and right shoulders.

Severity:

Low: Average Elevation Difference ≥ 1.0 in. & ≤ 2.0 in

Medium: Average Elevation Difference > 2.0 in & ≤ 4.0 in

High: Average Elevation Difference > 4.0 in

Extent:

Record the length of the segment for each severity having Shoulder Drop-off for left and right shoulders separately.

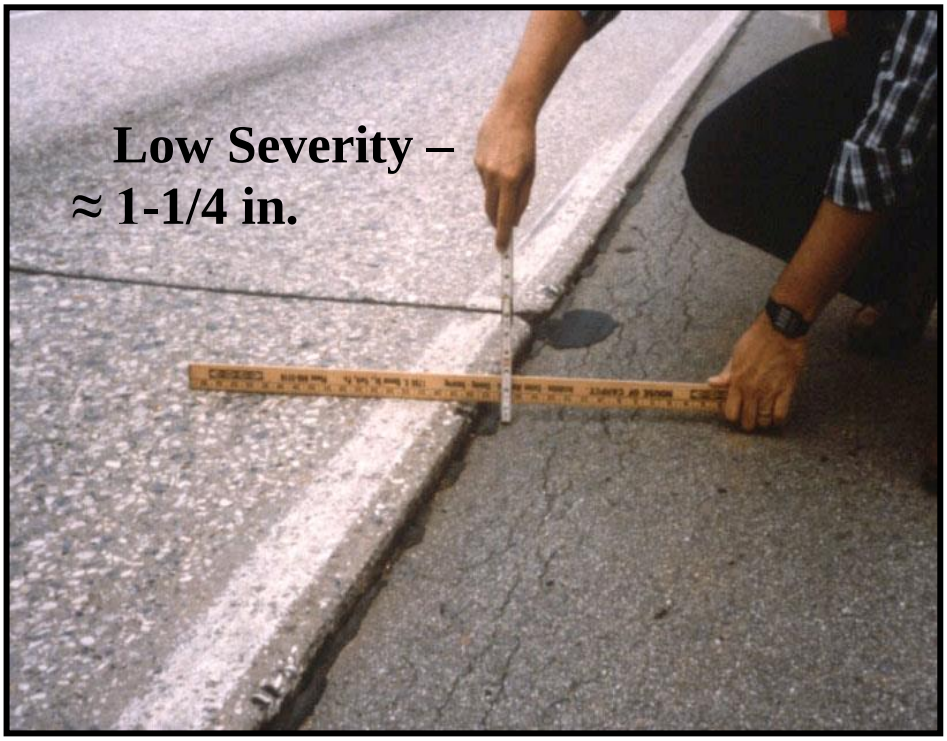
Example Reporting:

An 800-foot STAMPP segment has 200 feet with no Shoulder Drop-off and 600 feet of high severity Shoulder Drop-off. The rating for this section is 600 feet high severity Shoulder Drop-off (9).

DROPOFF			NONE	<10%	10-30%	>30%	LENGTH
				7	8	9	>4"
				4	5	6	>2" & ≤ 4"
			0	1	2	3	1-2"

(Actual form layout will vary)

Shoulder Drop-Off



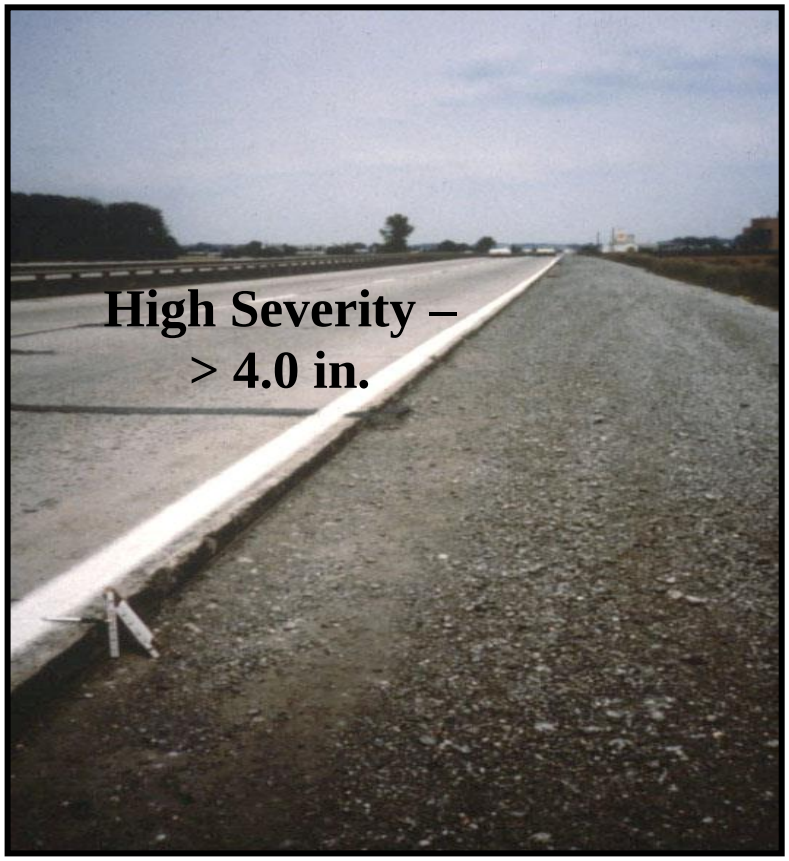


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PHOTO GUIDE

GUIDE RAIL/MEDIAN BARRIER SYSTEM TYPES

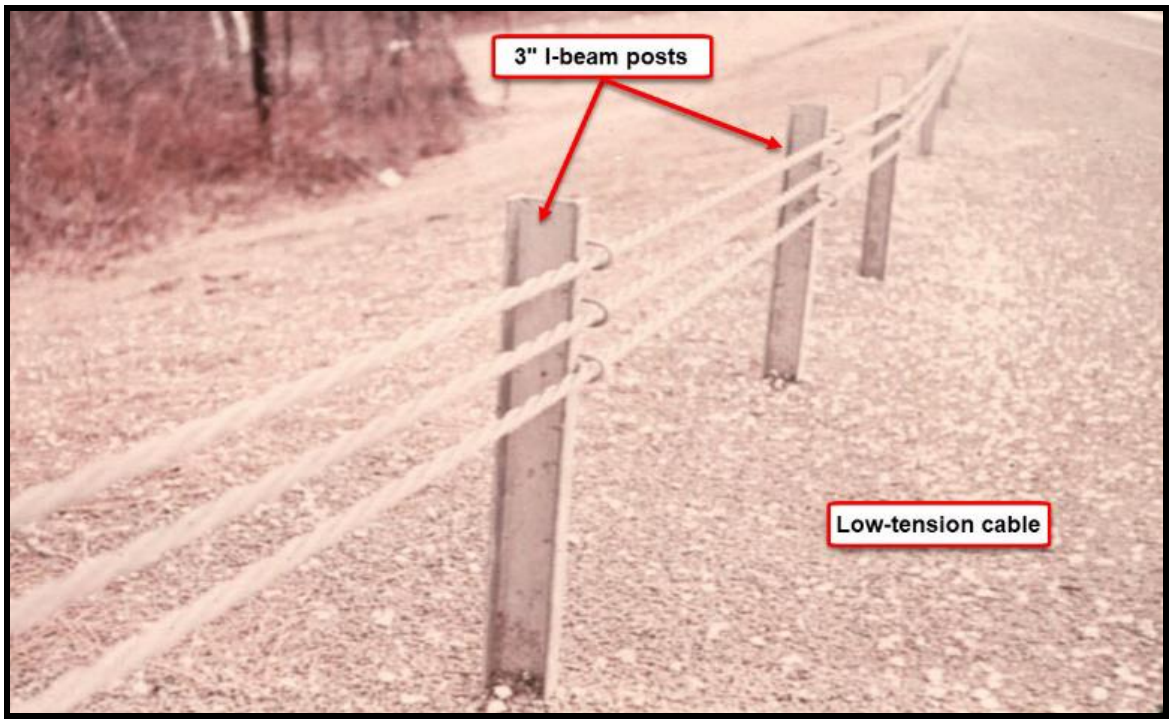
System Type A: Strong Post Cable

- This system may consist of 2, 3 or 4 cables with wood, steel or concrete posts.
- The spacing between posts is between 10 feet and 16 feet.
- The steel post is a 6” I-Beam.
- There may be a combination of post types present within a string of Type A.
- This type is not used for new installations.

Two Cable Steel Post Strong Post Cable System (6” I-Beams) With Two Cable Wood Post Strong Post Cable System

System Type B: Weak Post Cable

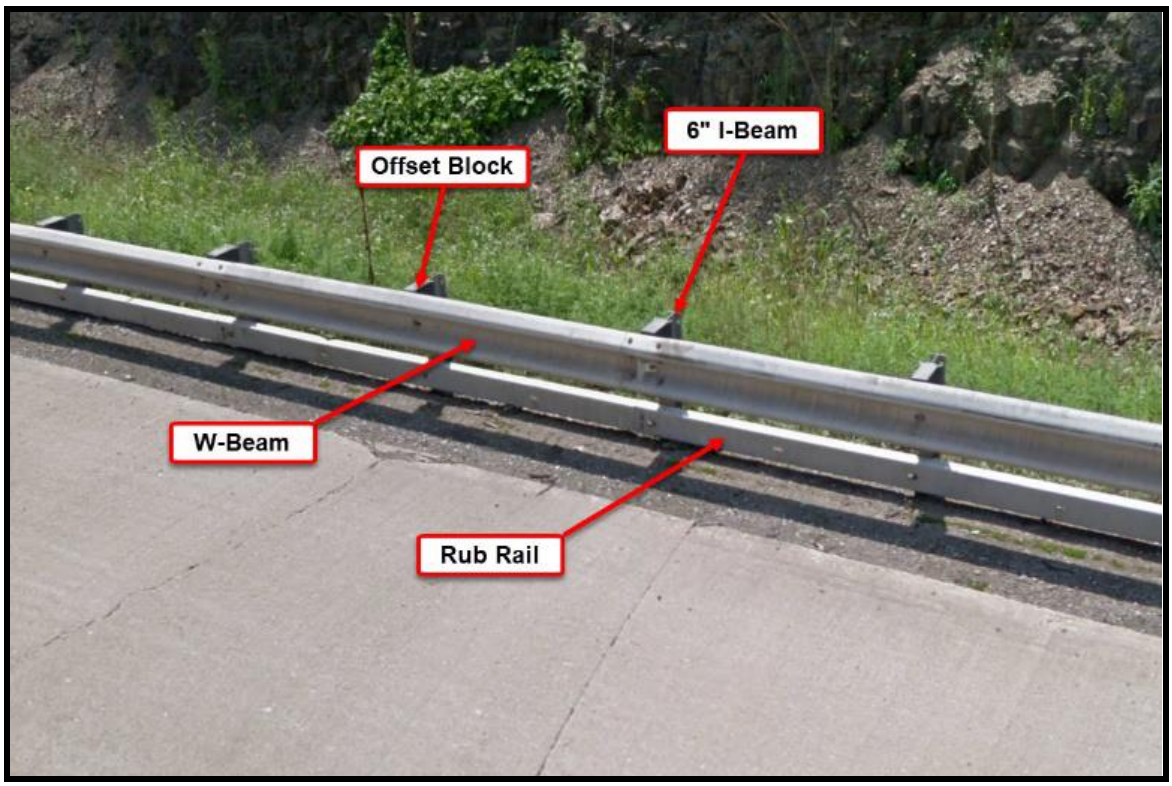
- This system may consist of 2, 3 or 4 cables.
- The posts on a weak post cable system are 3” steel I-Beams (only).
- The spacing between posts is typically 16 feet.
- Height to top of upper most cable is 30”
- This type is not used for new installations.



Three Cable Weak Post Cable System

System Type C: Strong Post W-Beam With Rub Rail and Offset Bracket

- W-Beam Guide Rail with 6” steel I-Beam posts.
- Offset Bracket holds W-Beam to post
- Offset Bracket moves the W-Beam rail away from the posts to prevent vehicles from snagging on posts.
- Rub Rail is placed below W-Beam, attached directly to the post.
- Rub Rail helps “guide” the vehicle along the guide rail and helps prevent the vehicle from snagging on the posts.
- Post spacing ranges from 3’-1 ½” to 6’-3”.
- Height to top of W-Beam is 27 ¾”.
- This type is not used for new installations.

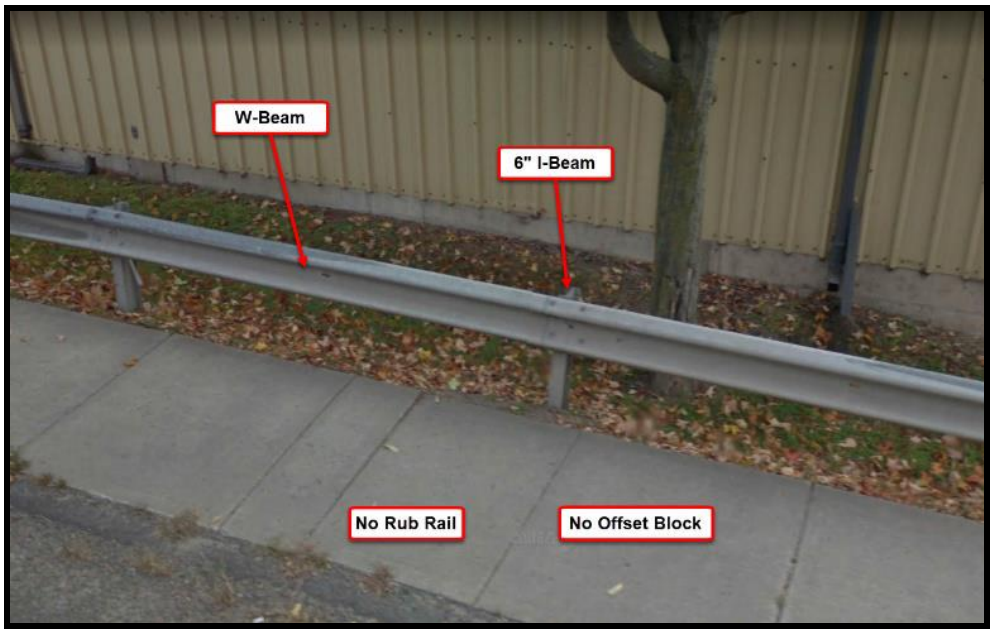


System Type D: Strong Post W-Beam With Offset Bracket (No Rub Rail)

- Same as System Type C except no Rub Rail; with Offset Bracket only.
- Steel offset brackets are no longer approved for new installations
- New installations use offset brackets made of wood, plastic or composite materials
- Post spacing ranges from 1'-6 ¾" to 3'-1½" to 6'-3".
- **W-beam rail elements have splices at the post.**
- Height to top of W-Beam is 27 ¾".
- This type is not used for new installations.

System Type E: Strong Post W-Beam
(No Offset Bracket, No Rub Rail)

- W-Beam rail on a 6” steel I-Beam post. This type is not used for new installations.
- Post spacing is 12’-6”. **W-beam rail elements have splices at the post.**
- Height to top of W-Beam is 27 ¾”.

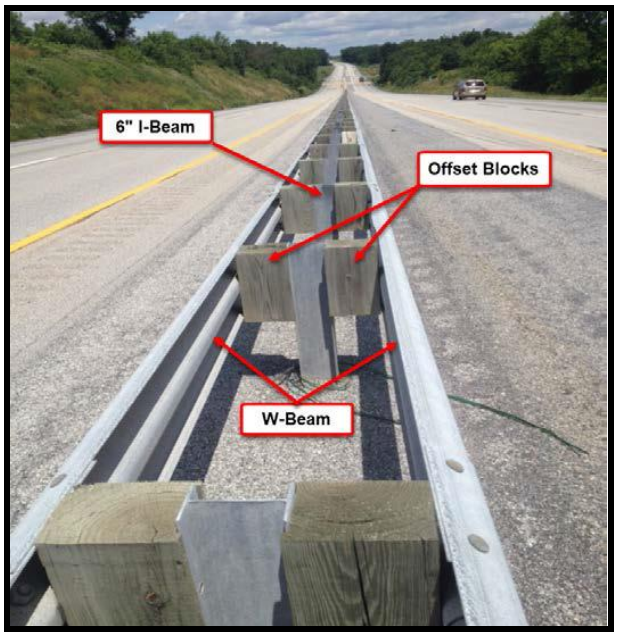


System Type F: Weak Post W-Beam

- W-Beam Rail on a 3” steel I-Beam post. This type is not used for new installations.
- Post spacing ranges from 3’-1 ½” to 6’-3” to 12’-6” **(spliced at the post).**
- The height to top of W-Beam is 30”.

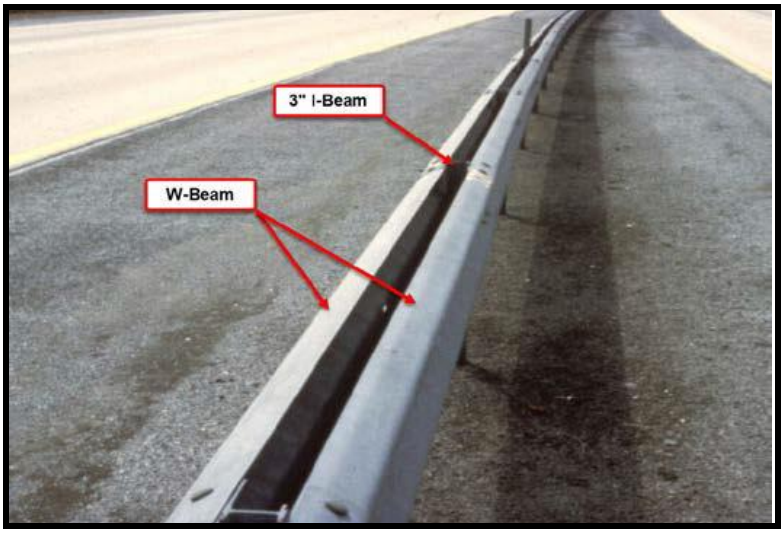
System Type G: Strong Post W-Beam, Double Faced

- This system has 6” steel I-Beam posts supporting W-Beam rail elements on both sides. This type is not used for new installations.
- Post spacing is 6’-3”. W-beam rail elements have splices at the post.
- Height to top of W-Beam is 27 ¾”.



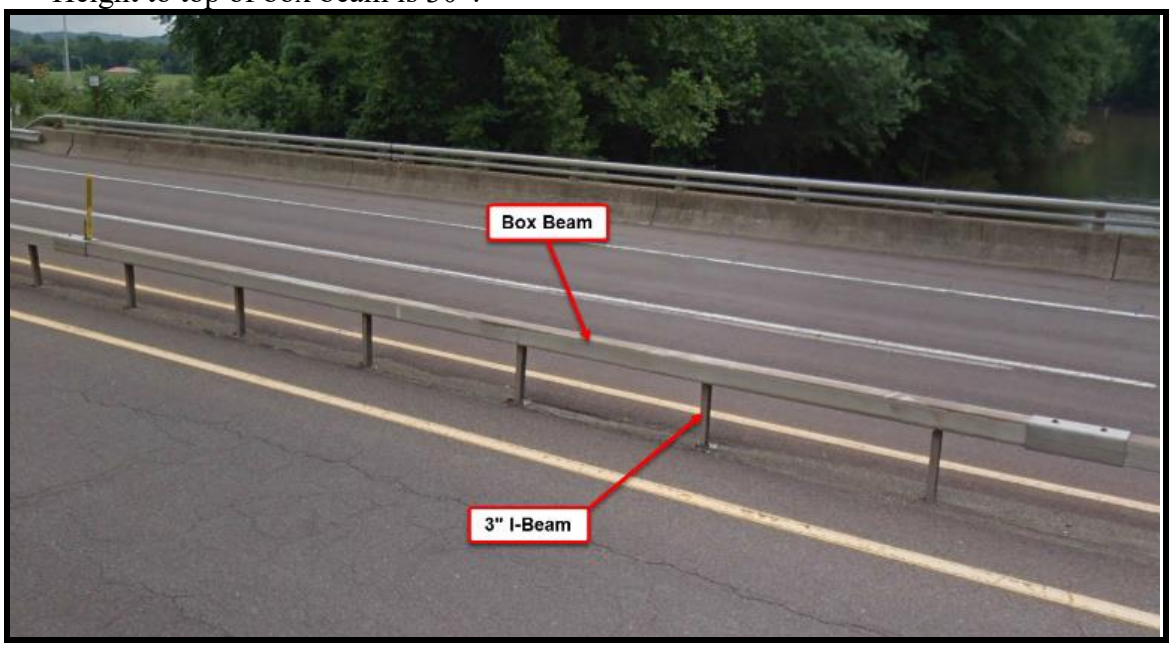
System Type H: Weak Post W-Beam, Double Faced

- The Type H guide rail system is no longer approved for installation. Existing installations need inspection.
- This system has 3” steel I-Beam posts supporting W-Beam rail elements on both sides.
- Post spacing is 12’-6”. Height to top of W-Beam is 32”.



System Type I: Weak Post Box Beam

- The Type I guide rail system is no longer approved for installation. Existing installations need inspection.
- This system has 3” steel I-beam posts supporting a box shaped rail element.
- Post spacing is 4’ to 6’.
- Height to top of box beam is 30”.



System Type J: Concrete Safety Shape

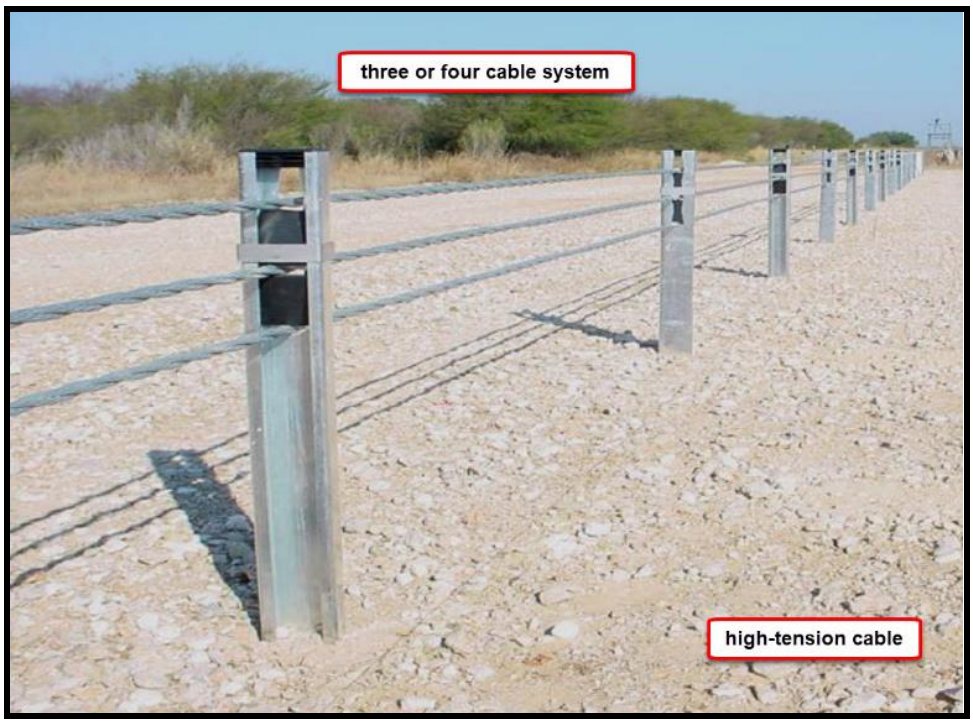
- Concrete barrier and concrete glare screen used in narrow medians on divided highways.
- Also used to channel traffic through construction zones.
- Height to top of concrete barrier is 32”, 42” or 50” (glare screen).

System Type K: IBC Barrier
(International Barrier Corporation Barrier)

- This system is no longer manufactured. Existing installations need inspection.
- This system is comprised of a series of interconnected metal bins.
- Bins are filled with fine aggregate such as sand.
- Height to top of barrier is 46”.

System Type L: Cable Safety System (CASS)

- This is a three-cable or four-cable system manufactured by Trinity Highway Products composed of ¾" pre-stretched high-tension cables with steel posts and generally used in medians.
- The spacing between posts is 16'5", 10', or 6'6" for C-Shaped post systems. I-Beam post systems have a typical post spacing of 20'.
- There may be a combination of C-Shaped and I-Beam post types present within a CASS.
- Height to top of upper most cable is 30" (typical).

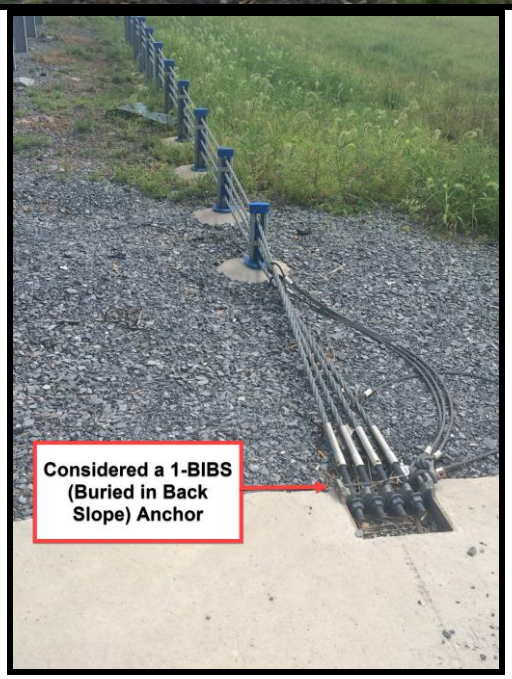


System Type M: Wire Rope Safety Fence (WRSF)

- This is a four-cable system manufactured by Brifen USA, Inc. and generally used in medians.
- Composed of ¾" pre-stretched high-tension cables with socketed steel posts.
- Maximum post spacing is 10'.
- Height to top of upper most cable is 36 ½" (typical). Bottom cable at 18" height (typical).

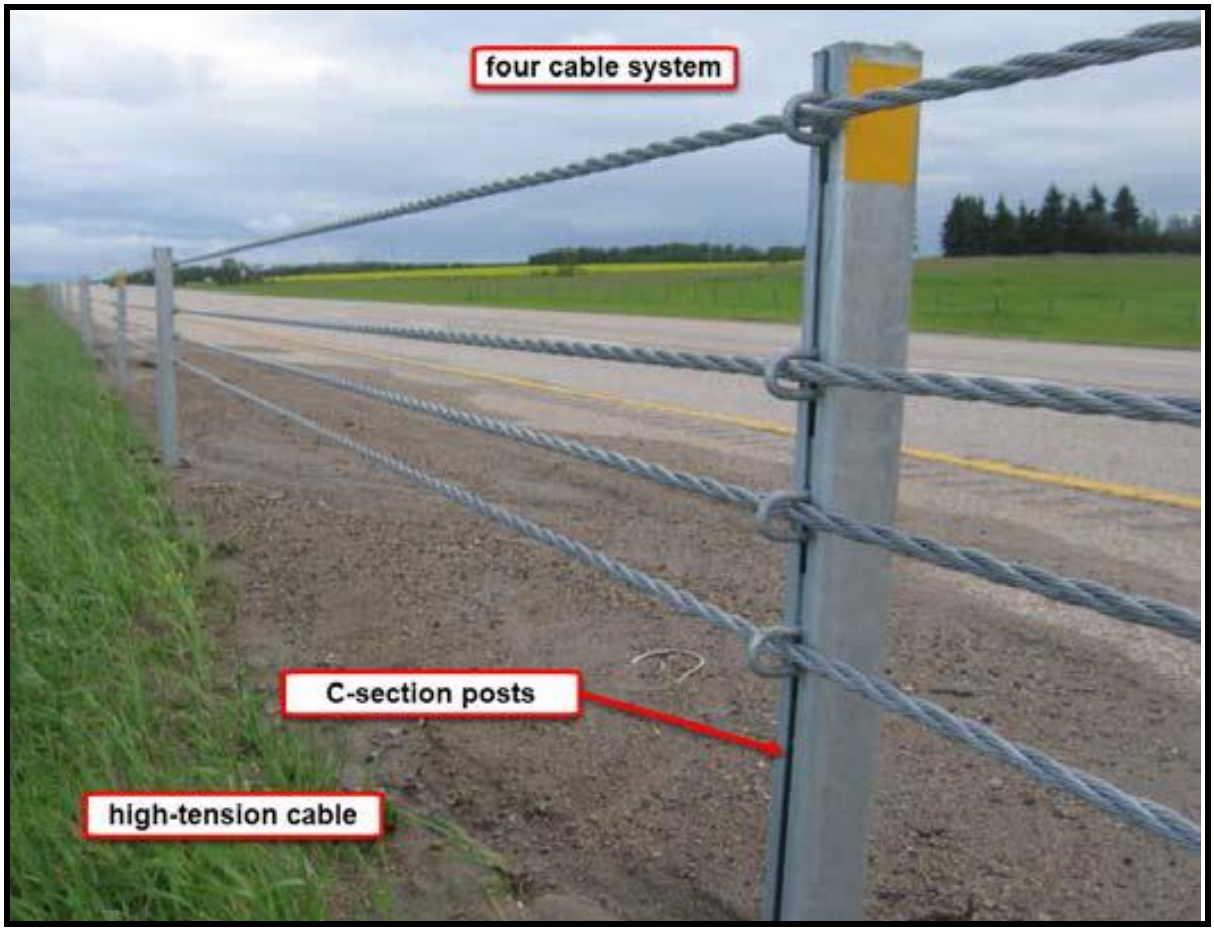
System Type N: SAFENCE

- This is a four-cable system manufactured by Blue Systems AB and generally used in medians.
- Composed of ¾" fully tensioned cables with steel posts.
- Maximum post spacing is 10'.
- Height to top of upper most cable is 28" (typical).
- No longer approved for new installations.



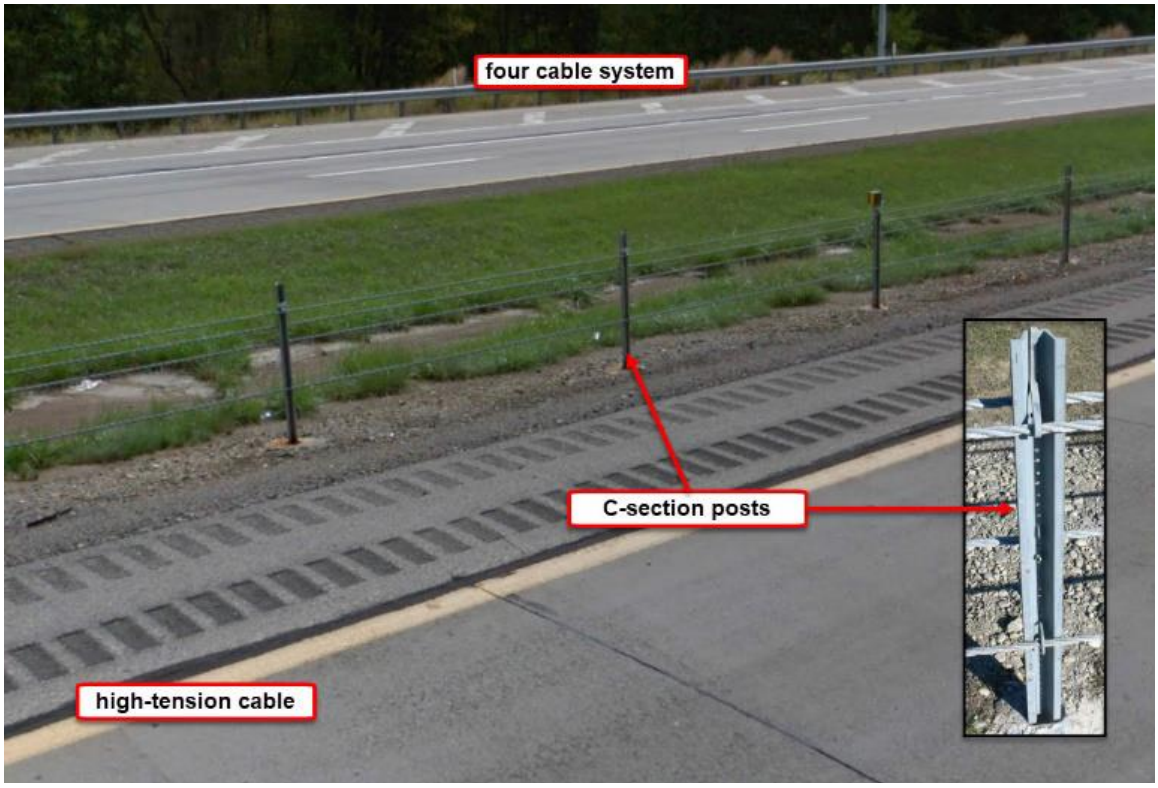
System Type P: Gibraltar

- This is a four-cable system manufactured by Gibraltar Cable Barrier Systems and generally used in medians.
- Composed of ¾" high tension cables with steel C-section posts.
- Maximum post spacing is 10'.
- Height to top of upper most cable is 39" (typical).



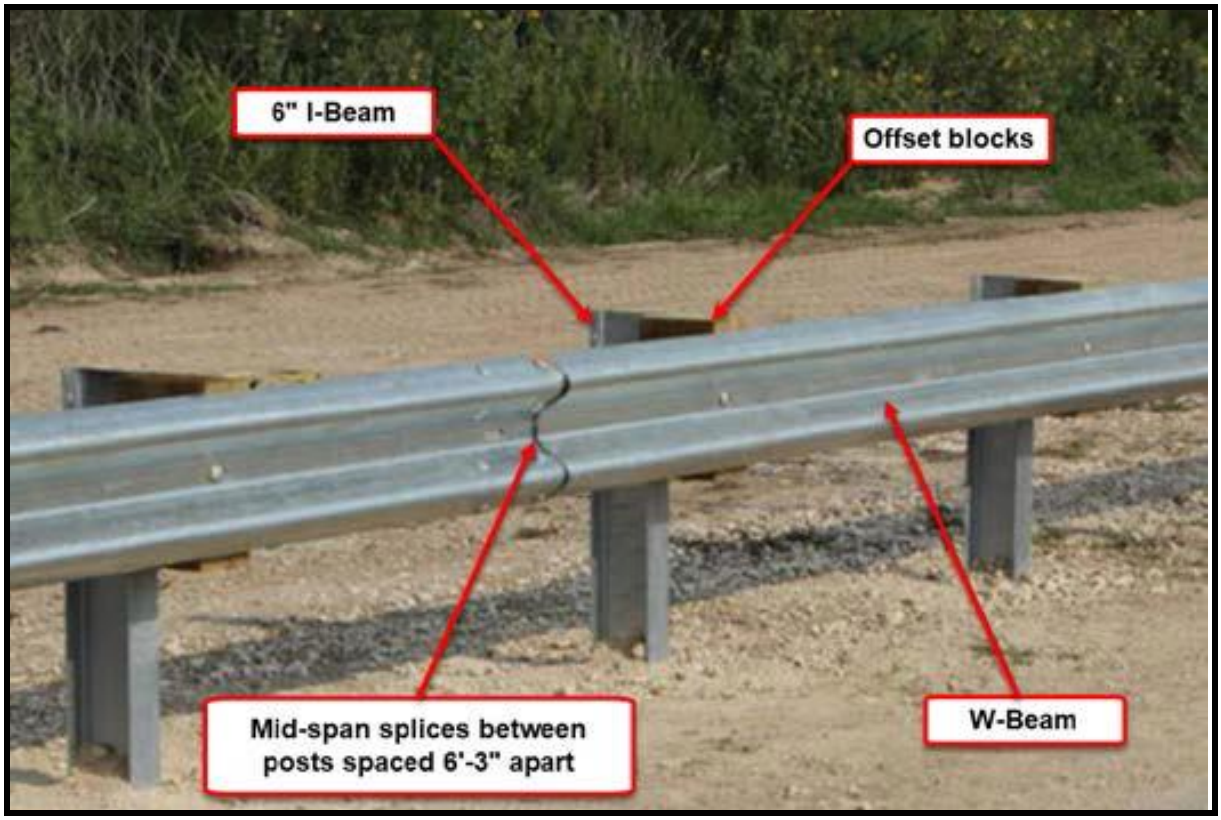
System Type Q: NU-CABLE

- This is a four-cable system manufactured by Nucor Steel Marion, Inc. and generally used in medians.
- Composed of ¾" high tension cables with steel U or C-section posts.
- Cables and posts attached with locking hook bolts.
- Maximum post spacing is 10'.
- Height to top of upper most cable is 35" (typical).



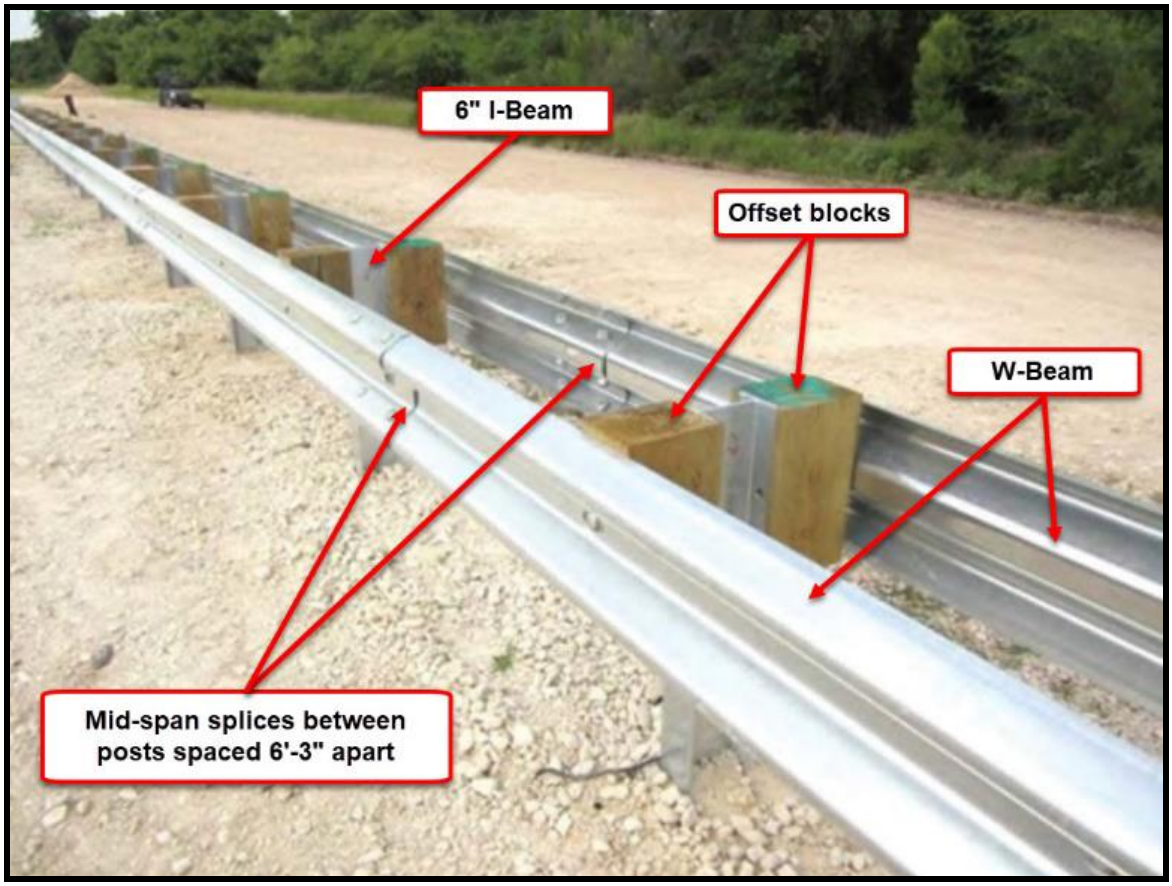
System Type R: 31” Strong Post W-Beam With Offset Bracket

- Steel offset brackets are no longer approved for new installations
- New installations use offset brackets made of wood, plastic or composite materials
- Post spacing ranges from 1’-6 ¾” to 3’-1½” to 6’-3”.
- **W-beam rail elements have mid-span splices between posts spaced 6’-3” apart.**
- Height to top of W-Beam is 31”.



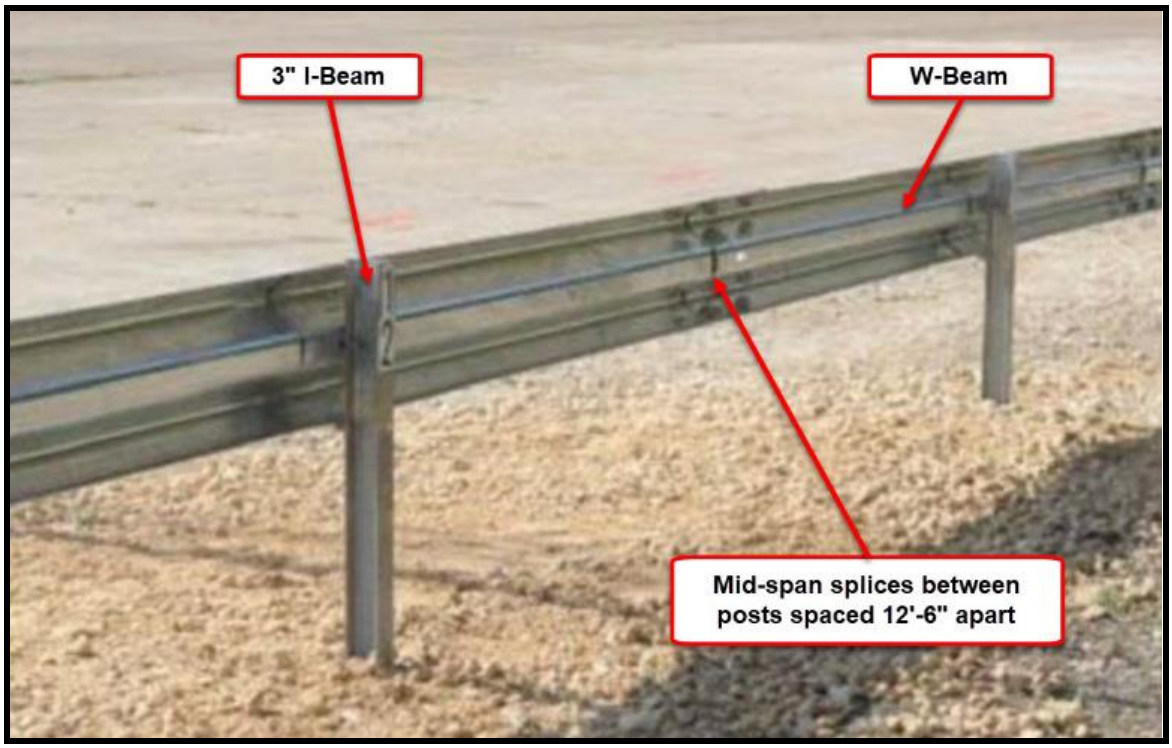
System Type S: 31” Strong Post W-Beam, Double Faced

- This system has 6” steel I-Beam posts supporting W-Beam rail elements on both sides.
- New installations use offset brackets made of wood, plastic or composite materials
- Post spacing is 6’-3”.
- **W-beam rail elements have mid-span splices between posts spaced 6’-3” apart.**
- Height to top of W-Beam is 31”.



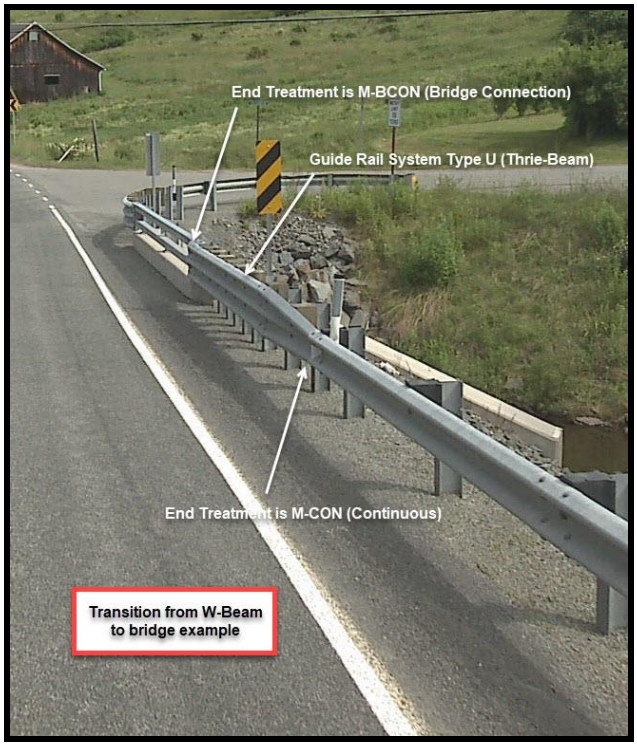
System Type T: 32” Weak Post W-Beam

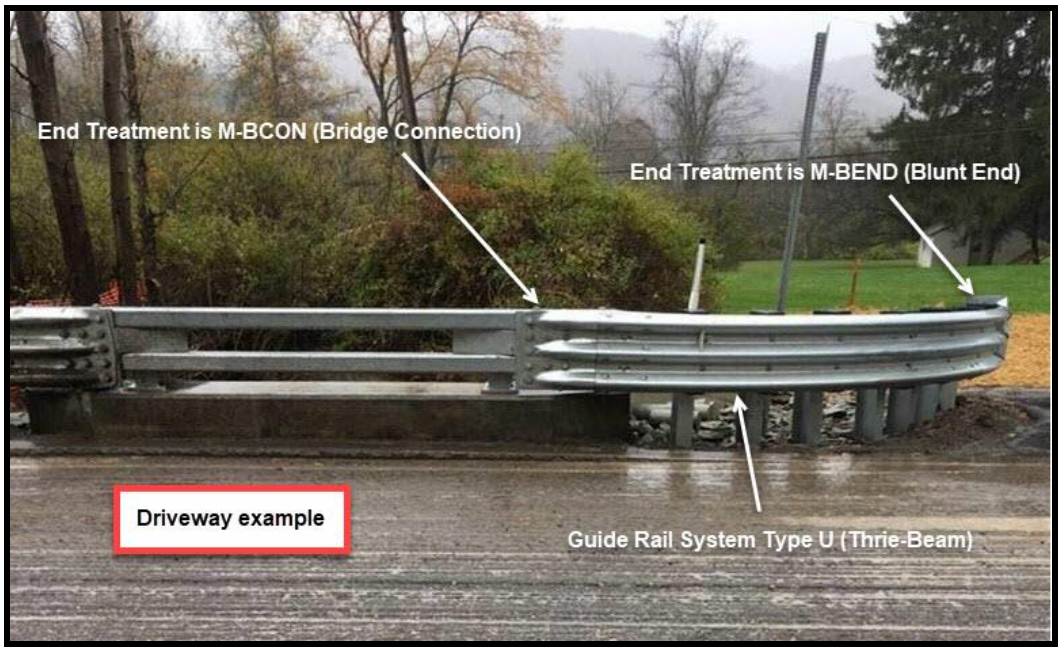
- W-Beam Rail on a 3” steel I-Beam post.
- Post spacing ranges from 3’-1 ½” to 6’-3” to 12’-6”
- **W-beam rail elements have mid-span splices between posts spaced 12’-6” apart.**
- The height to top of W-Beam is 32”.



System Type U: Thrie-Beam Bridge Transition

- "Thrie-Beam" rail on a 6" steel I-Beam post with wood or composite offset blocks.
- Serves as a transition from W-Beam systems to a bridge connection (M-BCON).
- Can also terminate at a driveway opening.
- The height to the top of a Thrie-Beam transition will vary based on the W-Beam system it's connected to.





System Type Z: Other

- Any system that was not previously described as type A through U will be considered "Other." All Type "Z" end treatments are considered "damaged."

System Type Z: Other

PHOTO GUIDE

END TREATMENT TYPES

End Treatment Type 1-BIBS: Buried in Back Slope

W-Beam Systems:

- Last panel is bolted to a concrete block or 6” steel posts.
- Concrete block (or steel posts) are buried in back slope at height of guide rail.
- Buried concrete blocks are not used for new installations.
- Single or double rail installations may be buried into the back slope

Strong Post Cable Systems:

- End anchor (metal rod) is attached to last post.
- Other end of anchor is bolted to buried concrete block.

Weak Post Cable Systems:

- All cables turned from last post
- Attached to buried concrete block

Concrete Barrier

- Buried in back slope at height of the barrier
- Consider damaged if the last section of concrete barrier is exposed

Undamaged/Damaged

Undamaged:

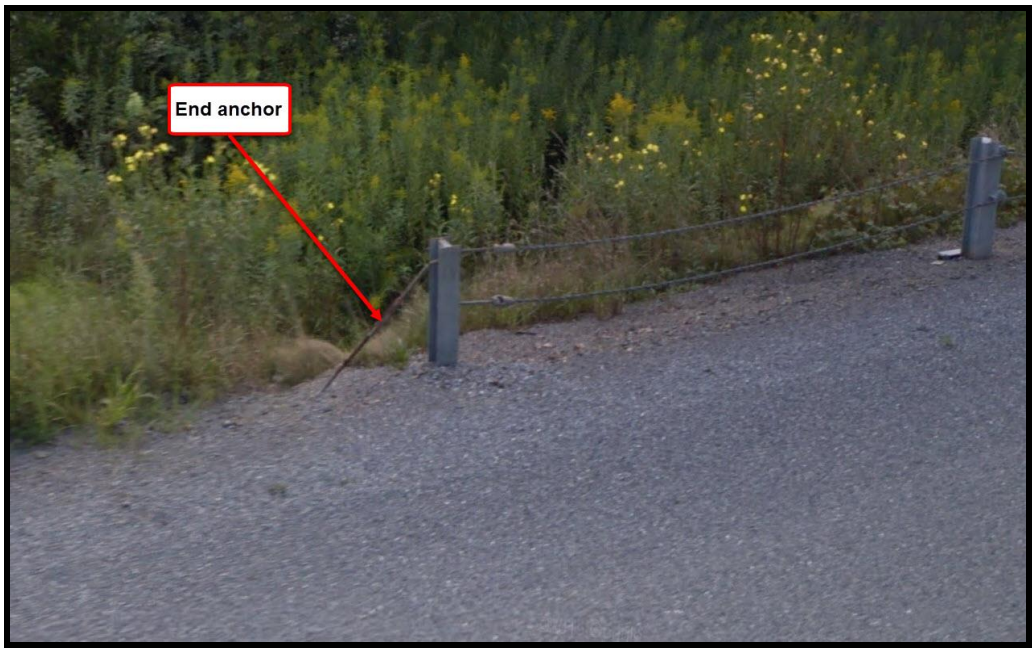
- Concrete Block (or Posts) Buried; Cable or W-Beam Attached
- W-Beam at Full Height

Damaged -

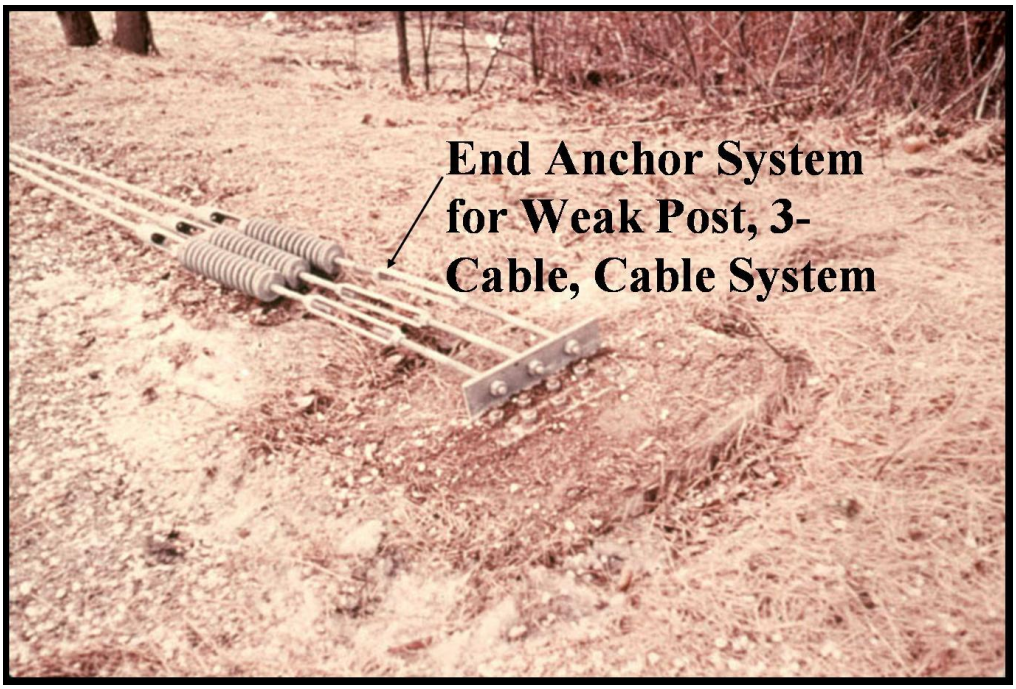
- Exposed Concrete Block (or Posts); Cable or W-Beam Disconnected
  W-Beam NOT at Full Height

Undamaged Type 1-BIBS for W-Beam Guide Rail

Example of double rail installation buried in back slope (1-BIBS).



Undamaged Type 1-BIBS (End Anchor) for Strong Post Cable Guide Rail



Undamaged Type 1-BIBS for Weak Post, 3-Cable, Cable Guide Rail. Similar for High-Tension Systems

Example of undamaged 1-BIBS for concrete barrier.

GATING, ENERGY ABSORBING TERMINAL END TREATMENTS (TYPE 2)

Energy absorbing terminals have been designed and developed to dissipate significant amounts of the kinetic energy in a head-on crash. These systems dissipate the energy of a vehicle impacting head-on by allowing the rail to pass through (gate) an extruder device at the end of the treatment. When a vehicle impacts a gating system at a sharp angle, the vehicle will pass through the system.

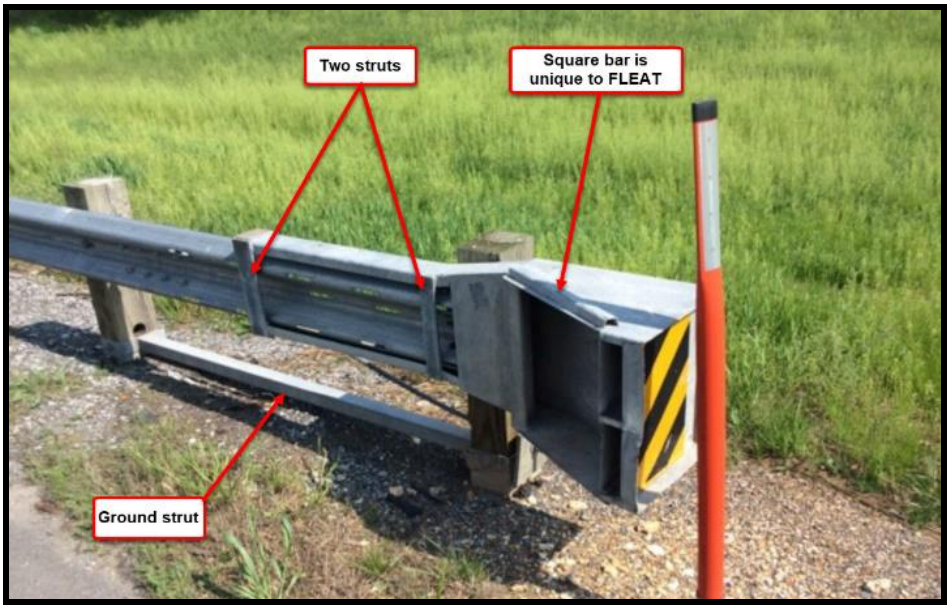
Energy absorbing terminals may be categorized as flared or tangent. Flared terminals are preferred because they are installed 4’ away from the edge of shoulder at the approach end.

Tangent terminals are used when the area required for flared terminals is not available and they are installed parallel to the shoulder with 1’ to 2’ offset at the nose. They will redirect vehicles for side angle impacts beyond the third post.

Both types require a clear runout area behind the end treatment since they are gating systems.

End Treatment Type 2-FLT: FLEAT-350

FLEAT-350 (Flared Energy Absorbing Terminal) is a flared (4' over the length of the end treatment) gating system designed to terminate W-beam guide rail for unidirectional traffic. The FLEAT-350 is not approved for new installations.



The impact head is driven along the rail when hit by a vehicle. Several weak posts will separate from the rail. The impact head forces the rail through an opening that flattens and kinks the corrugations as shown in the following two photos:

End Treatment Type 2-FLTS: FLEAT-SP

The FLEAT-SP is also a flared energy absorbing terminal system designed to terminate W-beam guide rail for unidirectional traffic. The FLEAT-SP is a two-post system and differs from the FLEAT-350 in the following ways:

- Post #1 has an enhanced upper and lower hinge.
- Post #2 has a hinged post with no ground strut.
- Post #3 and beyond may use generic standard guide rail posts and standard W-beam rail sections.

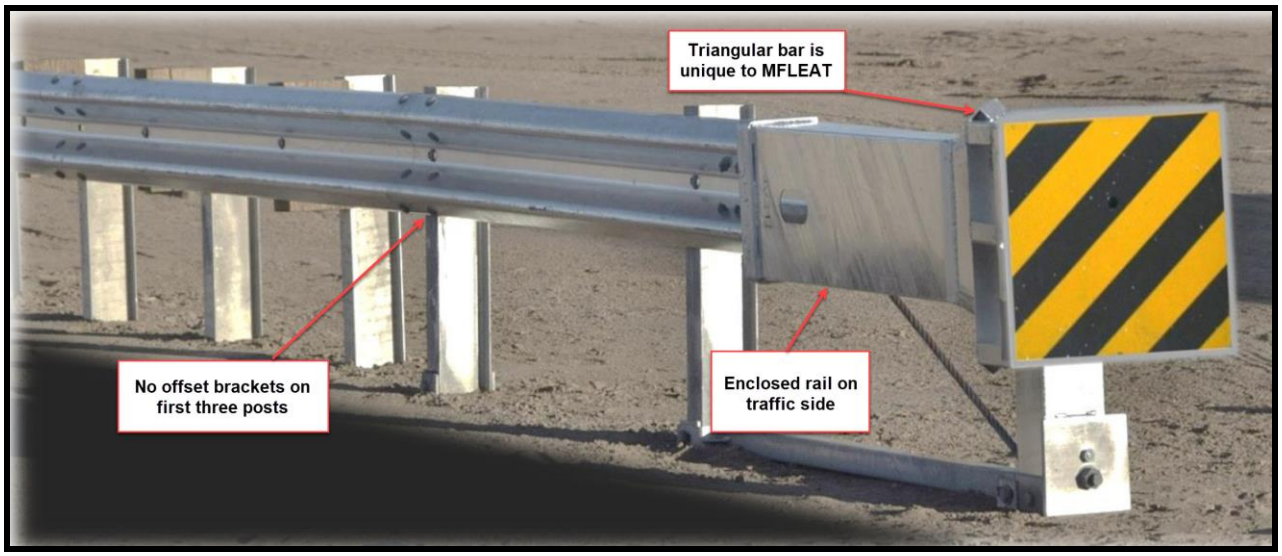
When impacted, the vehicle extruder head is driven along the rail, separating several weak posts from the rail. As the extruder head slides along the rail, it forces the rail through an opening that flattens and kinks the corrugations. The kinetic energy of an impacting vehicle is primarily absorbed in the flattening and bending of the rail.

(The FLEAT-SP is no longer approved for new installations.)

End Treatment Type 2-MFLT: MASH Compliant FLEAT

The MFLEAT (MASH Compliant FLEAT) is a flared energy absorbing end treatment consisting of an impact head assembly, a breakaway cable anchorage system with a ground strut, three W-beam rail sections, and eight posts.

- The terminal is installed with a straight flare of 3 ft offset over a length of 39.6 ft.
- The first, second, and third posts are not fitted with an offset bracket.
- During head-on impacts, the MFLEAT head slides over the W-beam guide rail. The rail is sequentially kinked as it moves through the impact head. The kinked guide rail exits the head and the vehicle is brought to a controlled stop.



End Treatment Type 2-XTEN: X-Tension

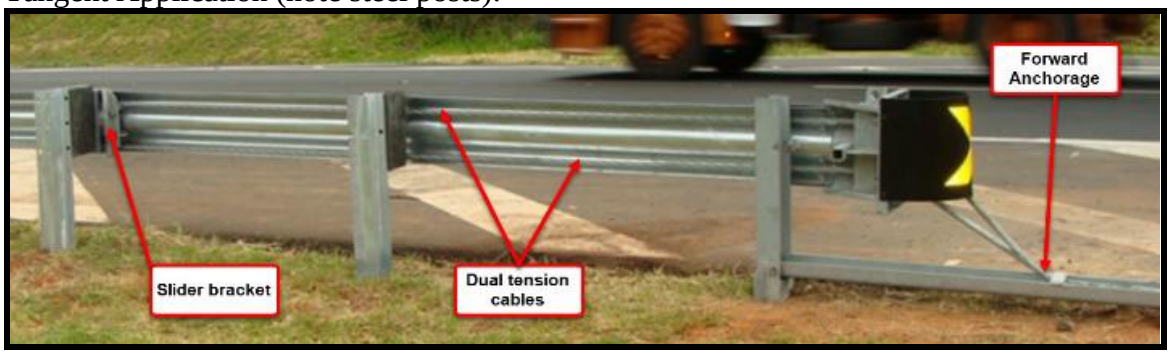
The X-Tension is a flared energy absorbing terminal system and a tangent energy absorbing terminal system designed to terminate W-beam guide rail for unidirectional traffic. The X-Tension is capable of redirecting vehicles impacting from the length of need, which starts at the first post.

In all end on impacts, varying amounts of energy are dissipated depending on the length of time the vehicle remains in contact with the impact head. During end on impacts the head, rail one and the slider, telescope over rail two until rail two comes to rest in the back of the impact head. At this point, the V notch bolts joining rail one and two are sheared allowing the entire rail one, head, slider and rail two assembly to slide over rail three. As the head is pushed down the two cables, the cables are pulled through the brake bar in a torturous path, which dissipates energy.

(The X-Tension is no longer approved for new installations.)

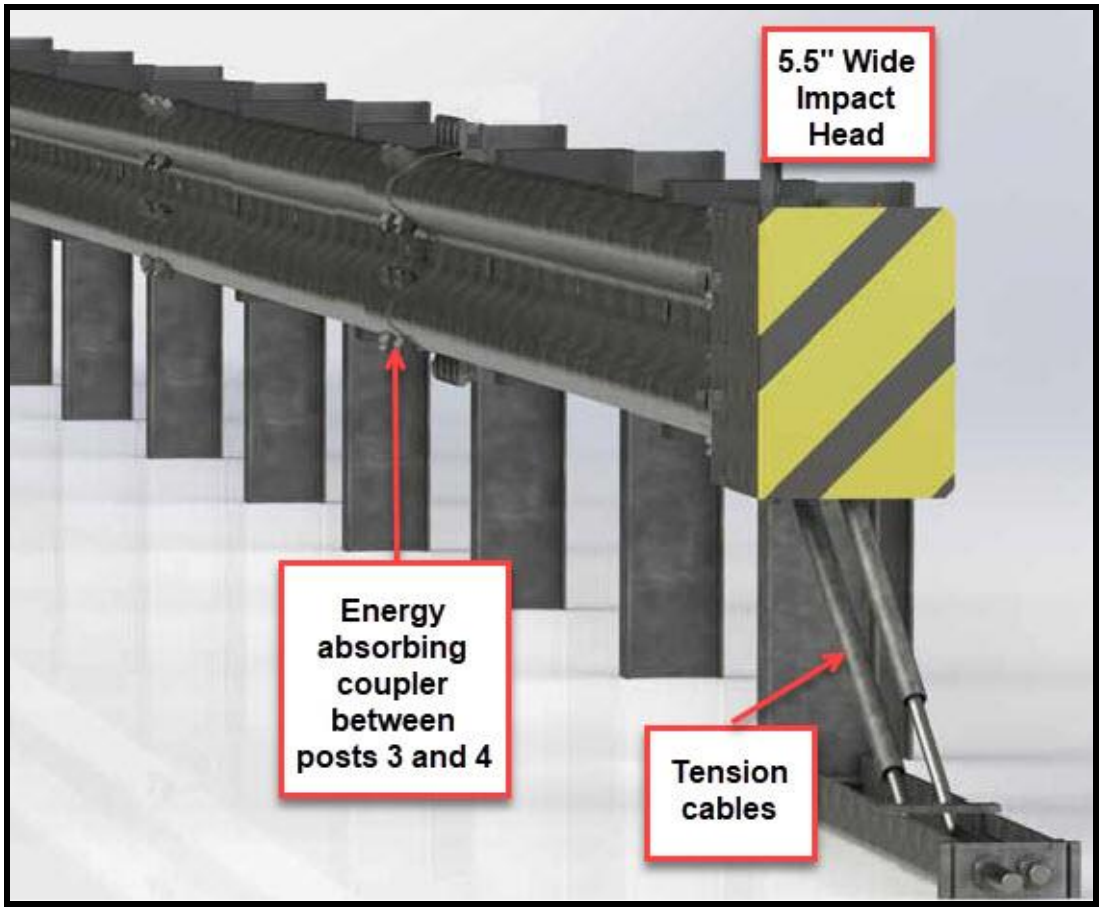
Flared Application (note wooden posts):

Tangent Application (note steel posts):



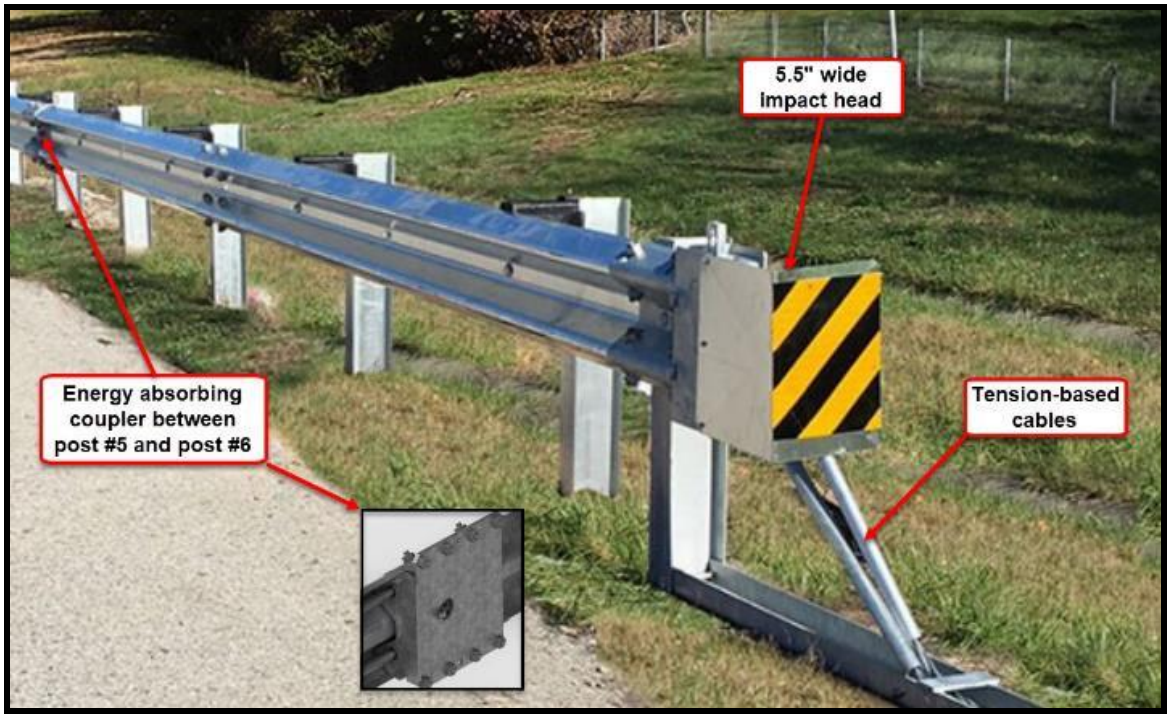
End Treatment Type 2-MTEN: MAX-Tension, Test Level 2

The MAX-Tension, Test Level 2 is a tangent energy absorbing terminal system. The system utilizes a tension-based design along with an energy absorbing coupler (between posts 3 and 4) that features a cutting tooth design. When impacted head-on, deceleration is controlled by friction developed in the tension cables and by cutting the downstream guide rail panels. When a side impact occurs, tension cables can help safely redirect a motorist away from the obstruction.



End Treatment Type 2-MTN3: MAX-Tension, Test Level 3

The MAX-Tension, Test Level 3 is a tangent energy absorbing terminal system. The system utilizes a tension-based design along with an energy absorbing coupler (between posts 5 and 6) that features a cutting tooth design. When impacted head-on, deceleration is controlled by friction developed in the tension cables and by cutting the downstream guide rail panels. When a side impact occurs, tension cables can help safely redirect a motorist away from the obstruction.



End Treatment Type 2-ET: ET-2000

This end treatment is no longer manufactured. Existing installations need inspection.

The ET-2000 is installed parallel to the roadway on the approach of strong post w-beam guide rail. The ET-2000 has a shoe at the end that is driven along the rail when impacted and several weak posts are separated from the rail. The rail in turn is forced through an opening that flattens the corrugations. The ET-2000 is considered gating up to post number 3 where redirection begins.

When this system is used with weak post w-beam guide rail, there will be a 50' section of strong post w-beam between the end treatment and the weak post w-beam.Consider this 50' length part of the end treatment (only when the guide rail is weak post w-beam).

End Treatment Type 2-ETPL: ET-Plus with SYTP (Steel Yielding Terminal Post)

The ET-Plus is no longer approved for installation. Existing installations need inspected.

The ET-Plus with SYTP is a cable-anchored, gating end treatment for use on the approach end of strong or weak post w-beam guide rail systems. The Steel Yielding Terminal Post is made of standard material with special shop-fabricated holes. Upon impact, the SYTP yields, allowing the ET-Plus head to flatten the rails and absorb the energy of an impacting vehicle. The ET Plus with SYTP is considered gating up to post number 3 (from the approach end) where redirection begins.

Note: The ET-Plus with SYTP can be distinguished from the ET-2000 by the use of steel terminal posts instead of wood and a taller, narrower extruder head.

For each ET-Plus location, the survey will be enhanced by the completion of the included ET-Plus End Treatment Inspection Checklist found at the end of this manual. The ET-Plus shall be marked as damaged if any items listed on the checklist get marked as "No" from the inspection. Each District is expected to keep their inspection checklists on file.

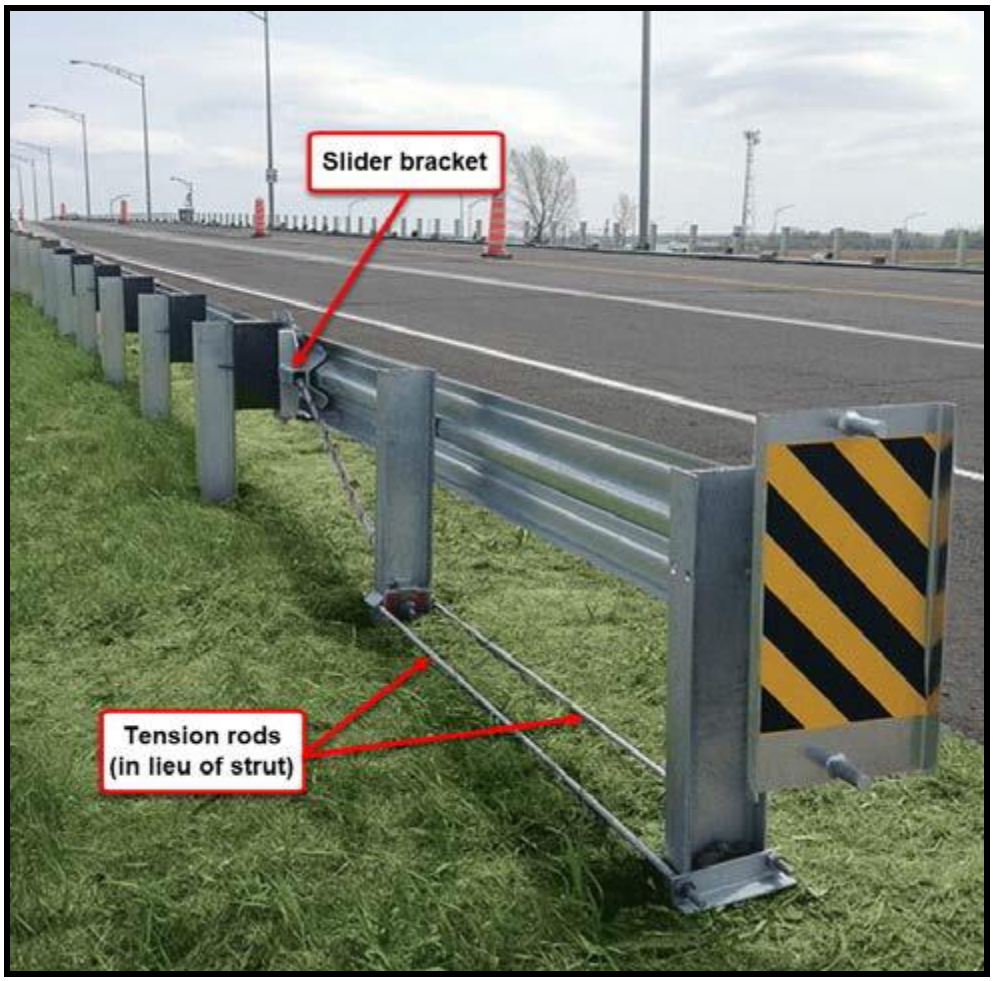
End Treatment Type 2-XLTE: X-LITE

This end treatment is no longer approved for new installations.

The X-LITE is a redirecting and gating end treatment which utilizes a telescoping, non-extruding design for w-beam guide rail systems. It can be used for flared or tangent roadside applications. The X-LITE has steel I-beam posts using wood or composite offset brackets.

This end treatment can be attached to concrete barrier systems when a proper transition is used.

Typical length of the X-LITE is 37’ 6’.



End Treatment Type 2-SKT: SKT-350 (Sequential Kinking Terminal)
And
End Treatment Type 2-BEST: BEST

Note: The BEST is no longer approved for installation. Existing installations need inspected.

The BEST and SKT-350 are similar end treatments. They are designed to be used on strong post w-beam guide rail. The impact head is driven along the rail upon impact from a vehicle, and several weak posts are separated from the rail. The rail in turn feeds through an opening that sequentially kinks the corrugations. Both systems can be installed parallel to the roadway or on a straight taper so the nose is 1' – 2' away from the edge of the shoulder. The systems redirect vehicles that impact the end treatment beyond the third post.

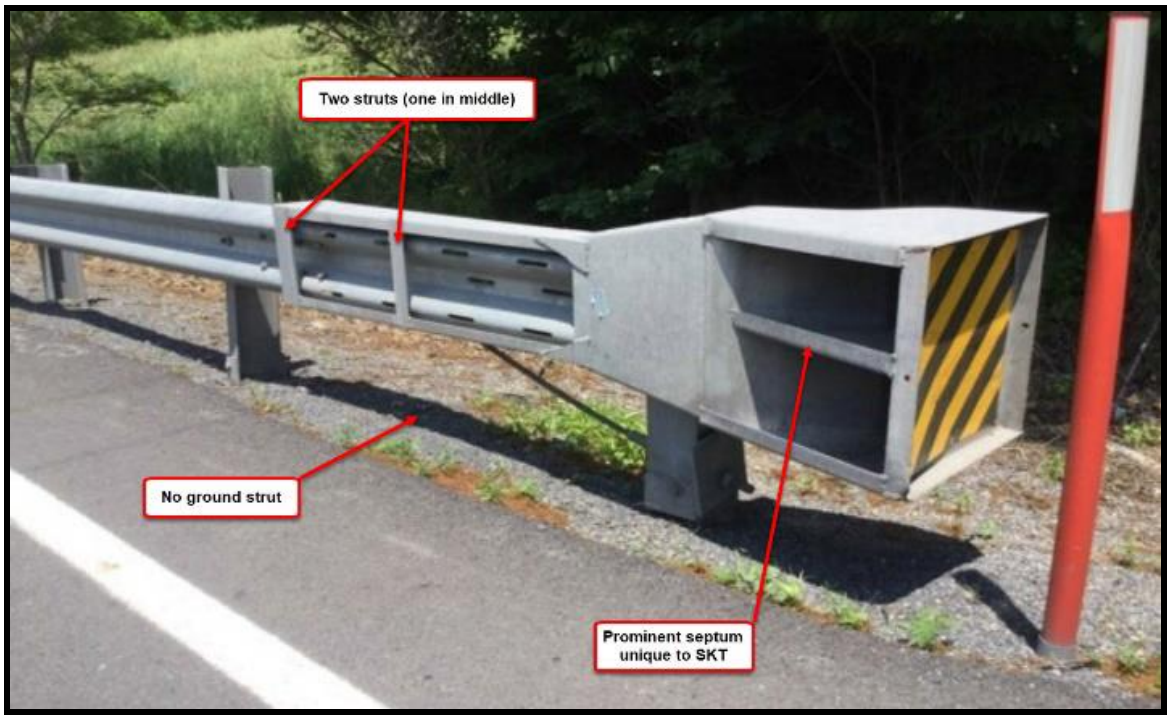
End Treatment Type 2-SKTS: SKT-SP

The SKT-SP is a tangent energy absorbing terminal system. The SKT-SP is designed to be used on the approach of a run of strong post W-beam guide rail. The SKT-SP is a two-post system and differs from the SKT-350 in the following ways:

- Post #1 has an enhanced upper and lower hinge.
- Post #2 has a hinged post with no ground strut.
- Post #3 and beyond may use generic standard guide rail posts and standard W-beam rail sections.

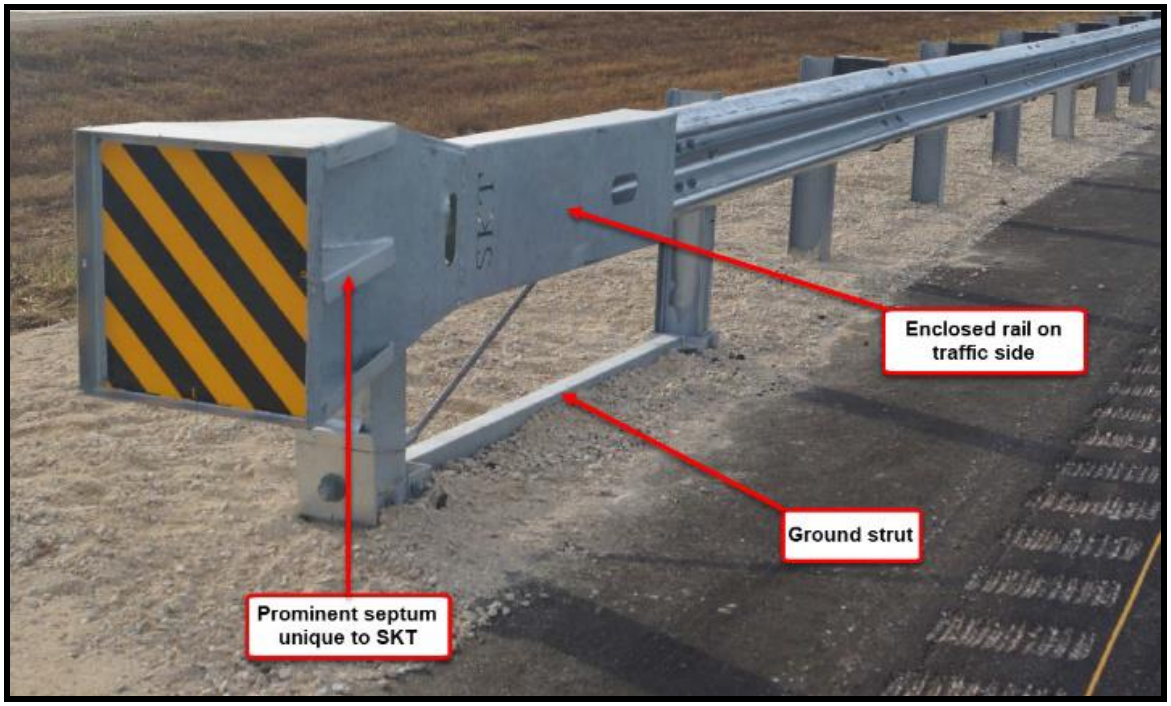
On impact, the impact head is driven along the rail, separating several weak posts from the rail. As the impact head slides along the rail, it feeds the rail through an opening that sequentially kinks the corrugations. The kinetic energy of the impacting vehicle is primarily absorbed through the kinking of the rail. The SKT-SP is 37.5 ft long and can be installed parallel to the roadway or with a straight taper to move the nose 1 or 2 feet away from the edge of the shoulder.

(The SKT-SP is no longer approved for new installations.)



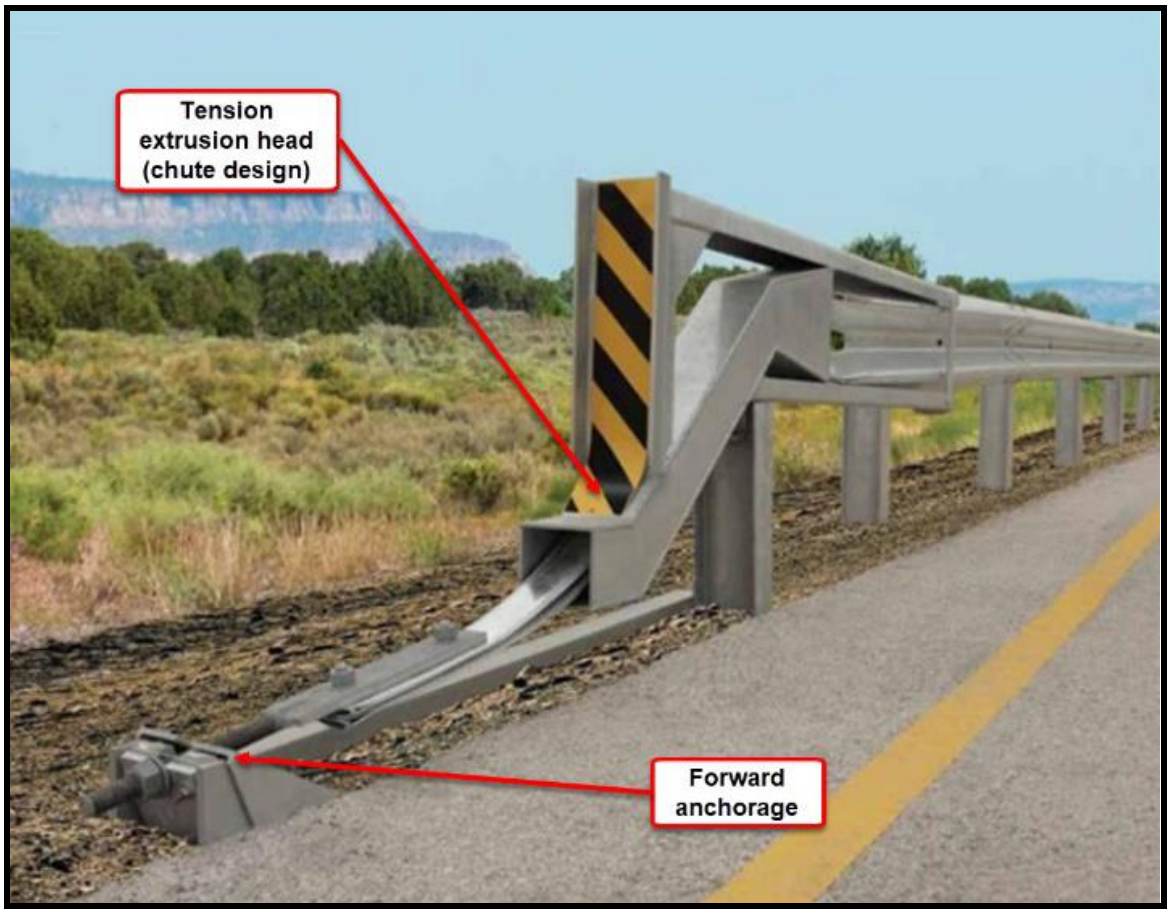
End Treatment Type 2-MSKT: MASH-SKT

The MSKT is a MASH (Manual for Assessing Safety Hardware) compliant tangent energy absorbing terminal. During head-on impacts, the MSKT head slides over the W-beam guide rail. The rail is sequentially kinked as it moves through the impact head. The kinked guide rail exits the head and the vehicle is brought to a controlled stop.



End Treatment Type 2-SOFT: SoftStop

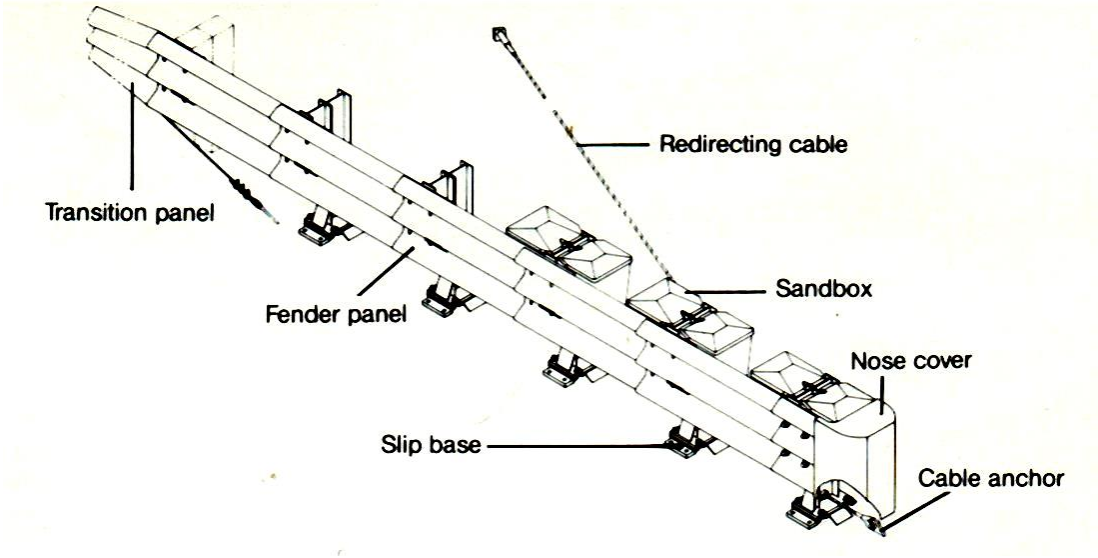
The SoftStop is a tangent energy absorbing terminal system. The front anchorage is designed to allow the rail panels to remain anchored during end-on impacts. The narrow head design helps to minimize nuisance impacts from vehicles and maintenance operations, such as mowing and snow removal. The SoftStop system contains an impact head, anchor rail, anchor post, angle strut, two Steel Yielding Terminal Posts, and required hardware accessories. The remaining length of the system beyond the second post uses system line posts, offset blocks and system rail.

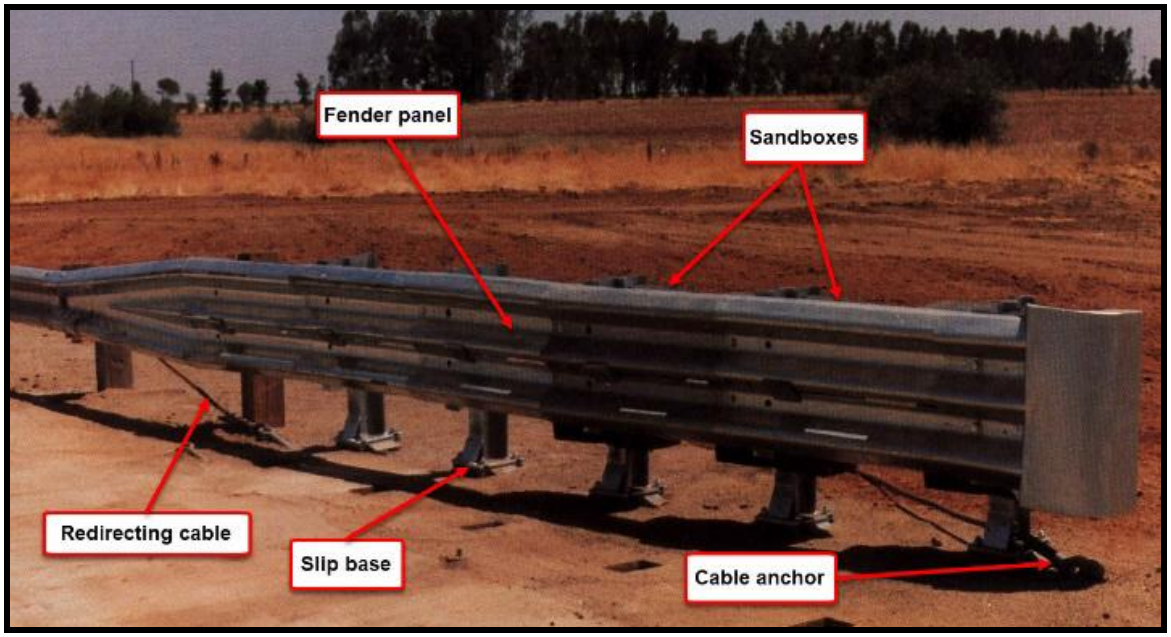


End Treatment Type 2-SNT: Sentre

Note: The Sentre is no longer approved for installation. Existing installations need inspected.

The Sentre system has telescoping panels and a redirecting cable. The panels collapse upon themselves longitudinally, when impacted by a vehicle, while the cable pulls the end treatment sideways. These actions guide the vehicle away from the guide rail hard spot. Sentre can be installed as a straight or flared end treatment.





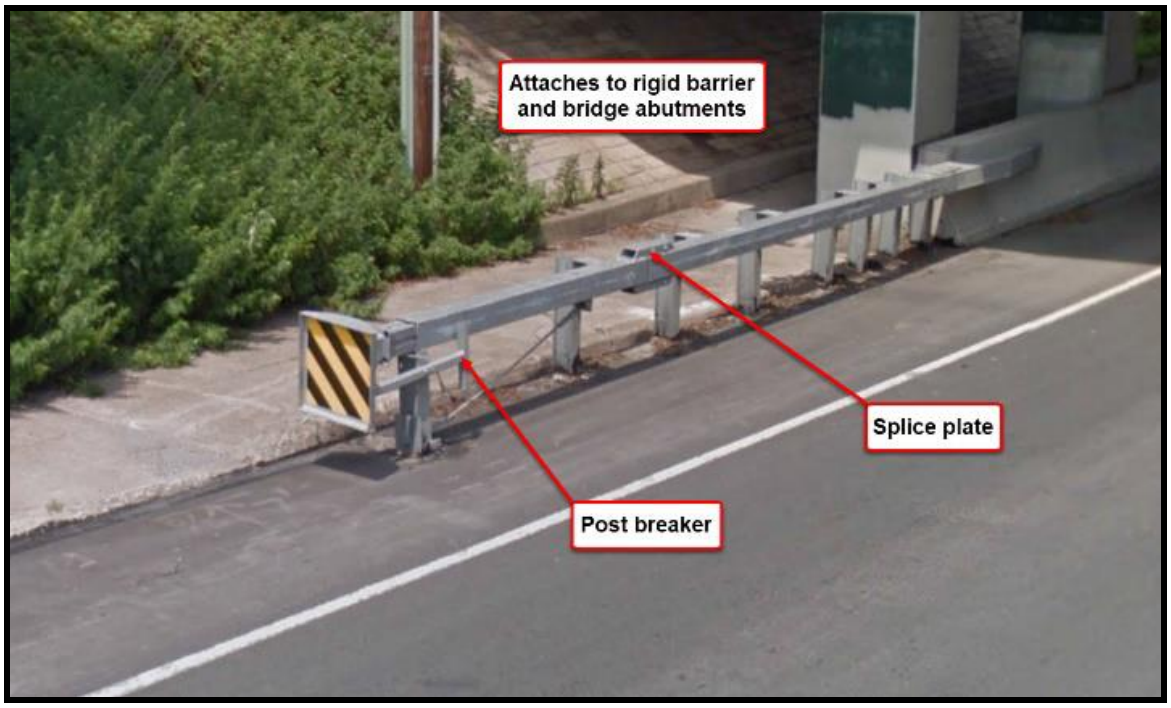
End Treatment Type 2-BTSS: BEAT-SSCC

The BEAT-SSCC is a tangent energy absorbing terminal system. The BEAT-SSCC attaches directly to rigid barrier, bridge abutments, and bridge rails and serves as both a transition and an end treatment. The BEAT-SSCC comes available with surface mounted posts or ground mounted posts; the ground mounted design does not need a concrete pad to be built.

The BEAT-SSCC is comprised of the following main components: (1) an impact head assembly; (2) a Stage 1 energy absorber (6 in × 6 in × 1/8 in) box beam rail; (3) a Stage 2 energy absorber (6 in × 6 in × 3/8 in) box beam rail; (4) eight breakaway steel posts; and (5) a fabricated end section for transitioning the BEAT-SSCC to a F-shaped concrete barrier.

The shortest length of the BEAT-SSCC is 28 ft. For sites needing additional length of need, the BEAT-SSCC is available in lengths of 32 ft, 36 ft, 40 ft and 44 ft.

(The BEAT-SSCC in no longer approved for new installations.)



End Treatment Type 2-YBET: WY-BET

The Wyoming Box-beam End Terminal (WY-BET) uses an oversized outer tube that telescopes over a standard box-beam rail element. When impacted, the terminal functions like the box beam guide rail to contain and redirect the impacting vehicle.

This end treatment can be used for shoulder and median applications and has a length of 50’ with a post spacing of 6’.

The WY-BET head is typically reusable after impact.

(The WY-BET is no longer approved for new installations.)

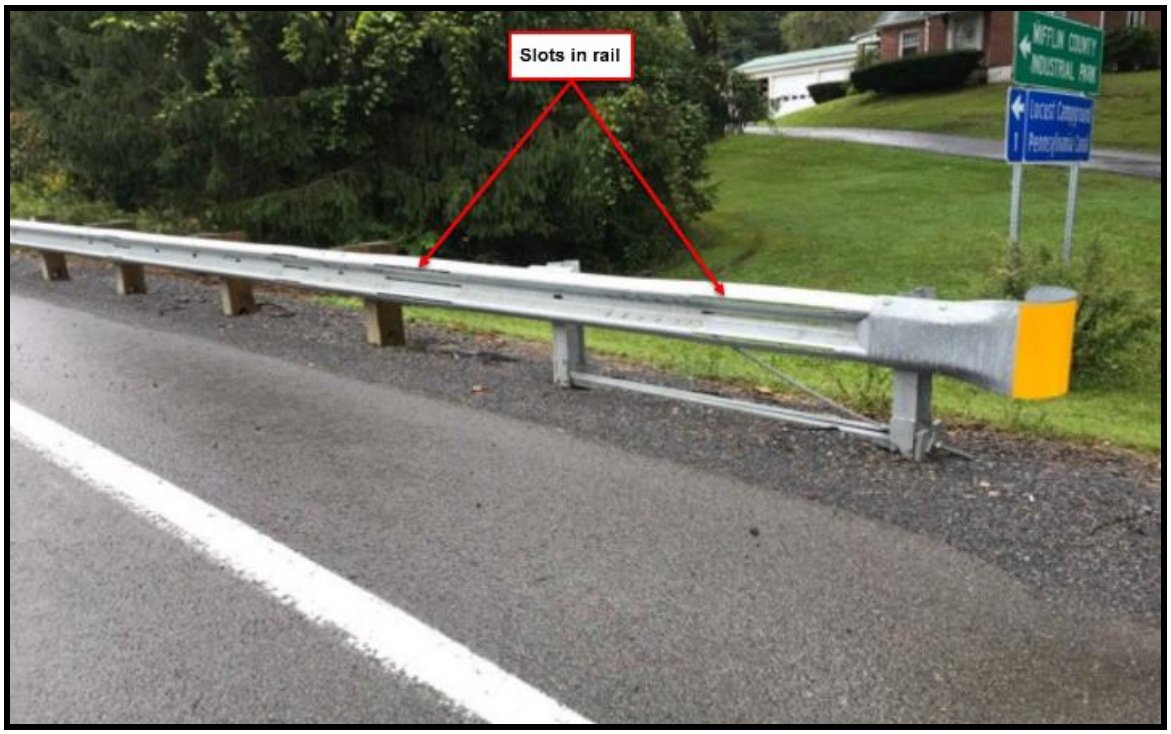
GATING, NON-ENERGY ABSORBING END TERMINALS (TYPE 3)

Non-energy absorbing terminals will allow an unbraked vehicle to travel over 150 ft behind and parallel to the guide rail installation or along the top of the barrier when struck head-on at high speeds. These end terminals are used on the approach end of single runs of Strong Post W-beam guide rail on either side of the roadway. They can also be used to terminate Weak Post guide rail with a 50 ft transition of Strong Post guide rail between the terminals and the Weak Post system.

End Treatment Type 3-SRT: SRT-350 (Slotted Rail Terminal)
AND
End Treatment Type 3-ROS: ROSS-350

Note: ROSS-350 is no longer approved for installation. Existing installations need inspected. The SRT-350 is shown in the image.

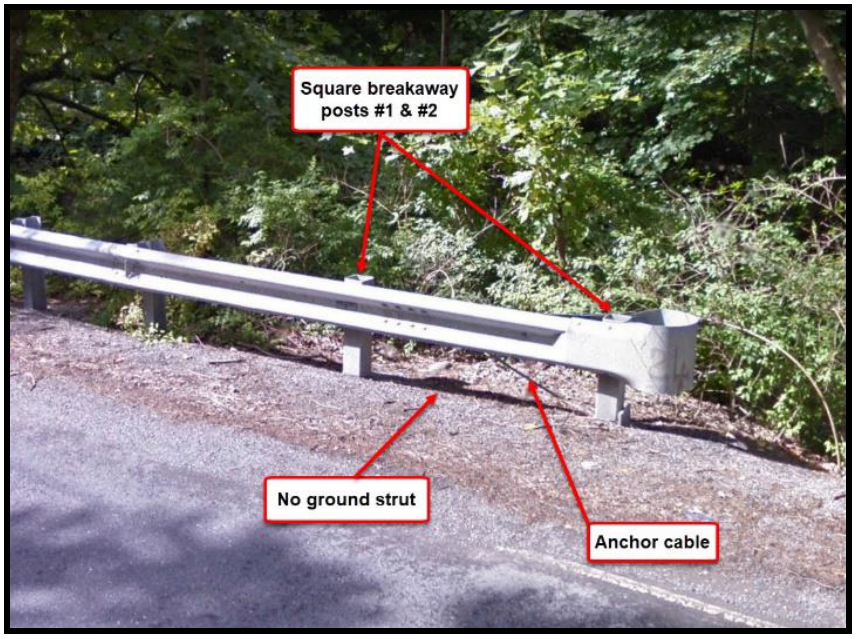
These systems have a 4' flare over the length of the end treatment and are similar in that they both have slots in the w-beam panels that provide the gating motion of the end treatment. There are also holes at the bottom of the wood posts that are part of the end treatment. These holes provide a weak spot in the posts, causing the posts to break, thus allowing the gating motion on head-on impacts and the vehicle to pass through the end treatment on side angle impacts. When these systems are used with weak post w-beam guide rail, there will be a 50' section of strong post w-beam between the end treatment and the weak post w-beam. Consider this 50' length part of the end treatment (only when the guide rail is weak post w-beam).



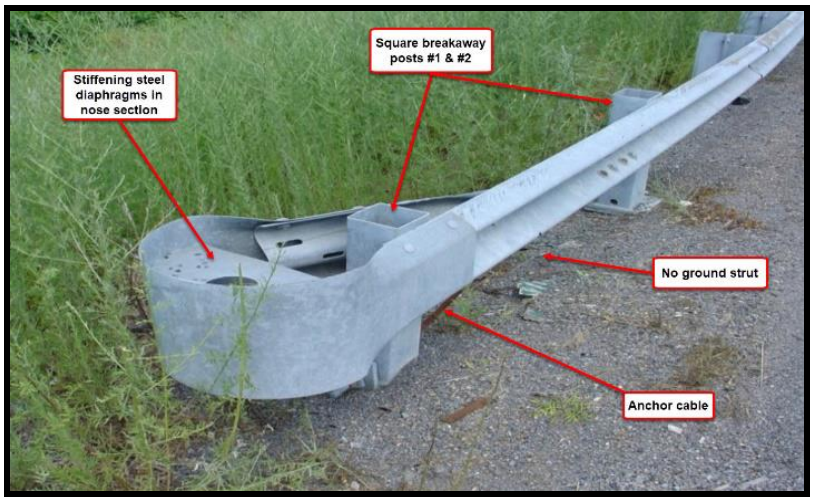
End Treatment Type 3-BCT: Breakaway Cable Terminal
And
End Treatment Type 3-MELT: Modified Eccentric Loader Terminal

Note: Both end treatments are no longer approved for installation. Existing installations need inspected.

The **BCT** assembly consists of a panel end section (used on strong post w-beam guide rail) that is 37-½' in length and flared 4' away from traffic over the length of the end treatment. There are 2 breakaway posts on the end, a cable assembly anchored to the end post, and a fist-like terminal section attached to that end post.



The **MELT** utilizes a standard BCT end section with the addition of two 0.1-inch thick steel diaphragms in the nose section.



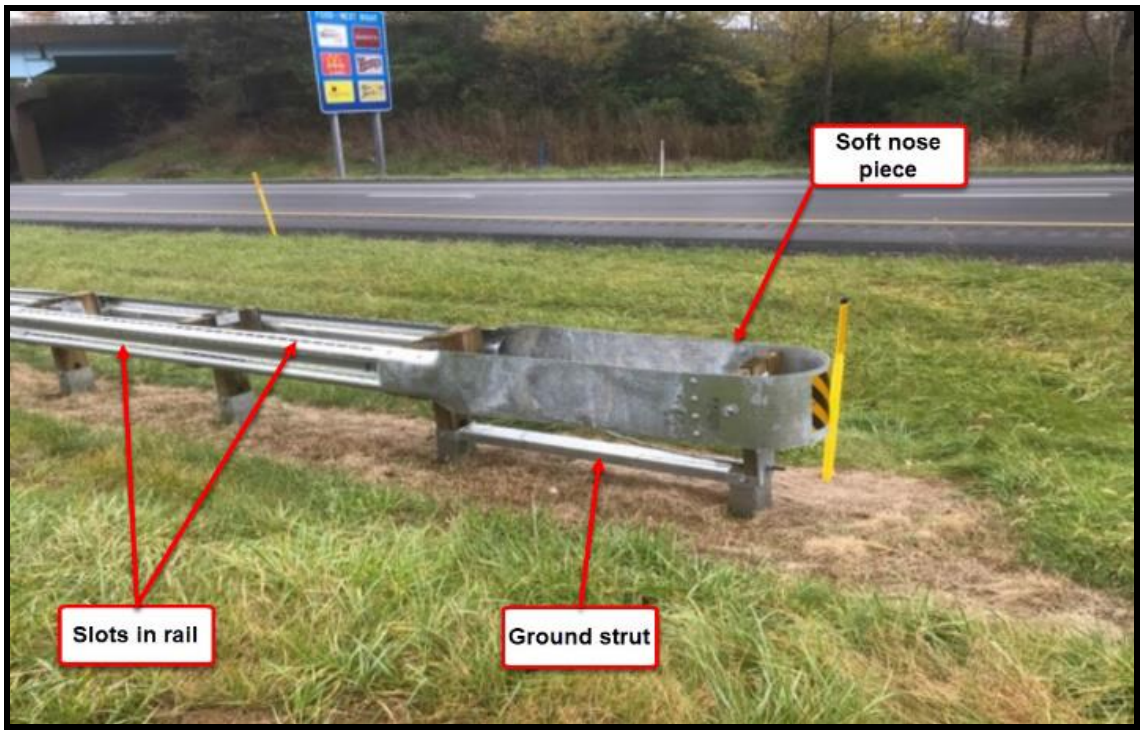
GATING, ENERGY ABSORBING TERMINAL/CRASH CUSHION END TREATMENTS (TYPE 4)

Type 4 systems use a variety of methods to dissipate the kinetic energy of an impacting vehicle in head-on crashes, arresting the vehicle in a controlled manner such that the risk of serious injuries to the occupants is minimized.

These systems can be used to terminate w-beam guide rail, concrete median barrier and double faced W-beam median barrier. They are typically used in roadway medians that are 10' wide or more, but also have application in shoulder and gore areas and on point hazards such as bridge piers. Redirection of the impacting vehicle begins at different points along each of the devices. Impacting vehicles will pass through the device on side angle impacts at the approach end.

End Treatment Type 4-CAT: Crash Cushion Attenuating Terminal

The CAT is a bi-directional and uni-directional energy absorbing crash cushion and end treatment. The CAT is a cable anchored three-stage system that utilizes a soft nosepiece, slotted .1" and .14" W-beam rails and breakaway wooden posts. The soft nose folds upon impact of a vehicle and acts as a buffer between the vehicle and the rest of the system. The rails are activated next. The rails shear out tabs of steel between adjacent slots in the guide rail until the vehicle has been stopped. A tail-end section is required to attach the CAT system to the existing barrier or fixed object. (No longer approved for new installations.)



End Treatment Type 4-BRK: Brakemaster

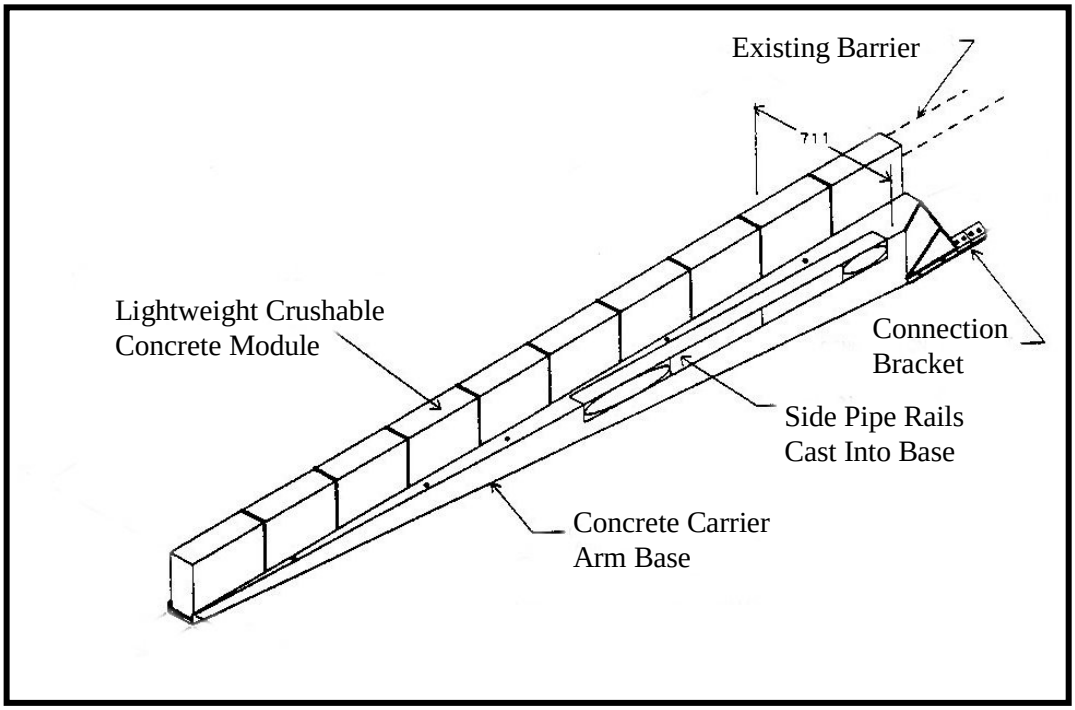
Note: The Brakemaster is no longer manufactured. Existing inventory of Brakemaster parts may still be used on projects.

The Brakemaster is used to protect a variety of narrow objects in low frequency impact areas in wide medians. The Brakemaster system has a framework of W-beam steel guide rail panels that move rearward when impacted head-on. There is a special braking mechanism that provides frictional resistance that brings the impacting vehicle to a stop. A tail section is required to attach Brakemaster to barrier or fixed objects.

End Treatment Type 4-ADM: ADIEM 350

The ADIEM 350 (Advanced Dynamic Impact Extension Module) is an energy absorbing end treatment. The ADIEM 350 has lightweight crushable concrete modules individually placed on a concrete carrier arm base. The base is anchored to the guide rail or barrier. Each module is designed to crush and slide on the carrier arm thus absorbing the impact energy of a vehicle.

(The ADIEM 350 is no longer approved for new installations.)



End Treatment Type 4-FLTM: FLEAT-MT

The FLEAT-MT (Flared Energy Absorbing Terminal - Median Terminal) is a proprietary end treatment for use in wide medians. The components of the original roadside FLEAT are combined with a couple of small additional components to create the FLEAT-MT. The FLEAT-MT attaches directly to median double-sided W-beam guide rail and can be used with wood or steel breakaway posts.

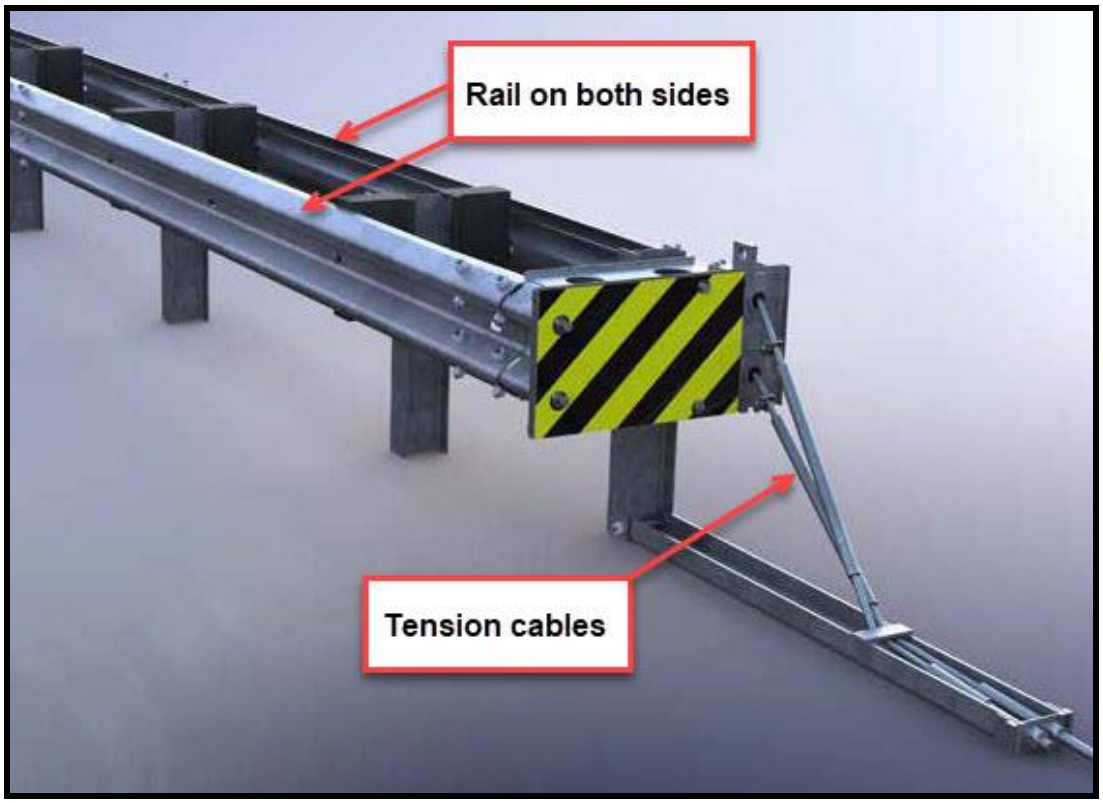
Two impact heads are required. One of the impact heads is at the fourth post in from the end of the barrier and fits over the backside W-beam rail element. The other impact head fits over the end of the traffic-side rail element ahead of the first and is offset from the face of the median barrier proper in a straight flare.

The front single-sided section of the FLEAT-MT is similar to the FLEAT-350 and functions the same. Depending on the severity of the impact, the vehicle may be stopped before reaching the second impact head at the fourth post. If the end-on impact is severe enough, the vehicle will activate the second impact head. This impact head will then begin to slide down the rail sequentially kinking the backside rail.

(The FLEAT-MT is no longer approved for new installations.)

End Treatment Type 4-TENM: MAX-Tension Median

The MAX-Tension Median is a redirective gating end treatment for double-sided, strong post W-beam guide rail systems in median or roadside configurations. This end treatment is comprised of an energy absorbing impact head, two tension cables, two support cables, two releasable posts (post 1 and post 2), a ground anchor assembly, a panel coupler, and an energy absorbing panel coupler with integrated cutting tooth. This end treatment can be applied directly to double-sided W-beam guide rail at, or transitioned to, 31-inch rail height with panels and post spacing configured at mid-span splice.

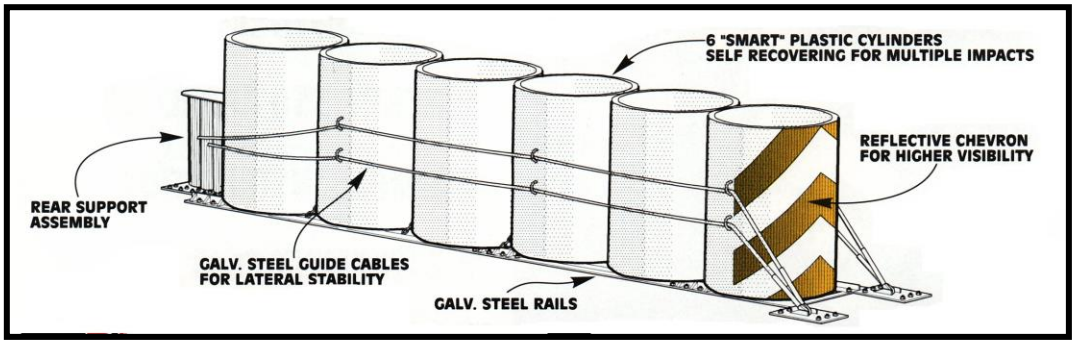


NON-GATING, ENERGY ABSORBING TERMINAL/CRASH CUSHION END TREATMENTS (TYPE 5)

These systems can be used to terminate concrete median barrier, double-faced W-beam median barrier and other obstructions. They are used in narrow or wide roadway medians. They have application in shoulder and gore areas and on point hazards such as bridge piers and other wide obstructions. These systems use various methods to dissipate the kinetic energy of an impacting vehicle in head-on crashes. The redirection point of these devices begins at the approach end of the device meaning they are non-gating.

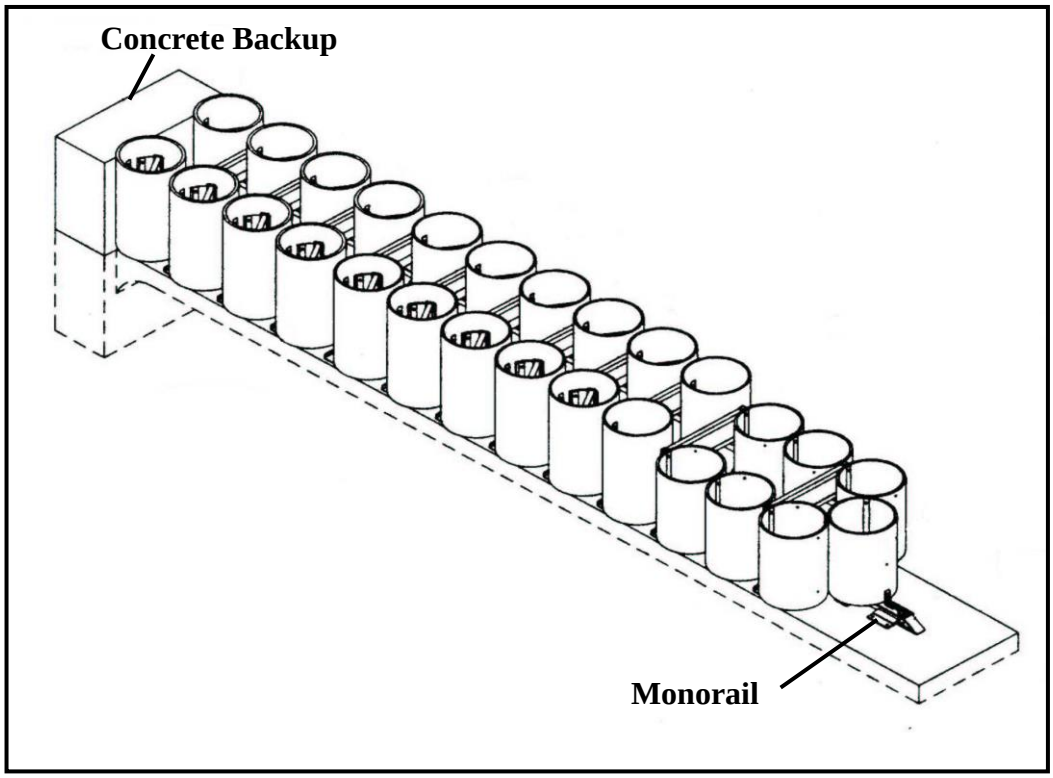
End Treatment Type 5-RACT: REACT 350

The REACT 350 (Reusable Energy Absorbing Crash Terminal) features configurations of 4, 6 or 9 reusable "smart plastic" cylinders. The REACT 350 cylinders with a cable system along each side attenuate head-on impacts and redirect severe side angle hits. The cables are connected to anchor plates at the front of the REACT 350 and to a backup assembly at the rear of the unit. The units are entirely self-contained and can be used for permanent or temporary applications. (No longer approved for new installations.)



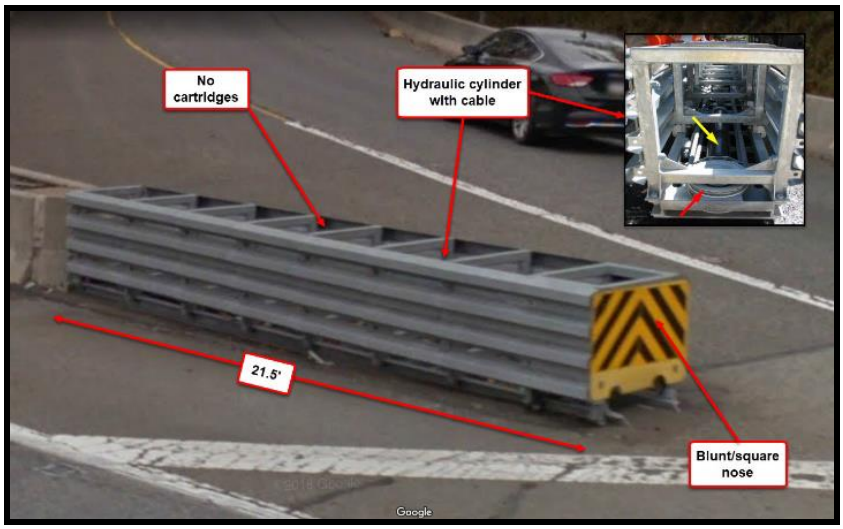
End Treatment Type 5-RE60 – REACT 350(60”)

The REACT 350(60”) is a re-directive, non-gating, reusable crash cushion. The REACT 350(60”) consists of 27 “smart plastic” cylinders in 14 rows attached to a monorail by means of diaphragms. The cylinders can have various wall thicknesses to accommodate light cars and heavier trucks. The REACT 350(60”) can be mounted to a new or existing concrete backup and is capable of shielding hazards up to 60” wide. (No longer approved for new installations.)

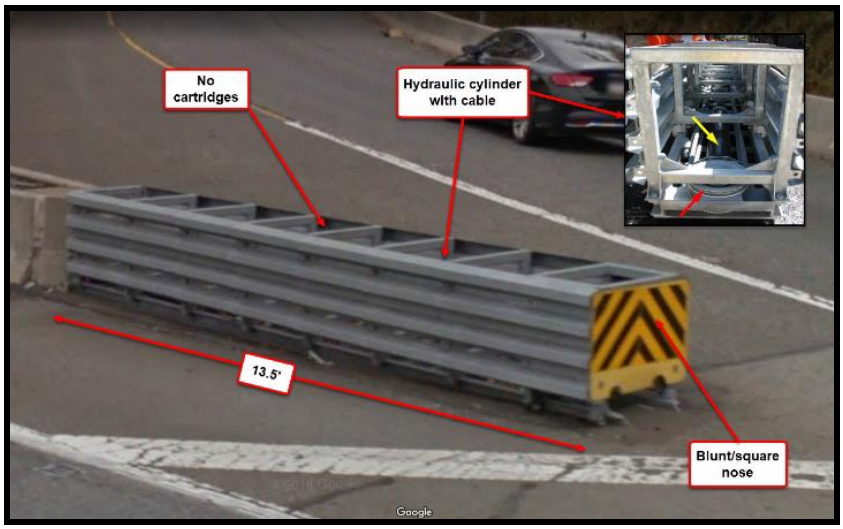


End Treatment Type 5-SCI: SCI100GM
And
End Treatment Type 5-SCI7: SCI70GM

The SCI100GM (Smart Cushion Innovations Crash Cushion) and SCI70GM are re-directive, non-gating, low maintenance impact attenuators and are intended for use to terminate median barrier. Both systems can be used for unidirectional or bidirectional traffic. The units consist of a base, support frame, sled, side panels, wire rope cable, sheaves, and a shock arresting cylinder. The base is anchored to the mounting surface and provides support for the frame. The support frame holds the side panels that provide an outer flat re-directive surface for side impacts. The sled provides re-directive support for side impacts and deceleration force for frontal impacts. The SCI100GM is 21.5 feet long and the SCI70GM is 13.5 feet long. (No longer approved for new installations.)



5-SCI: SCI100GM



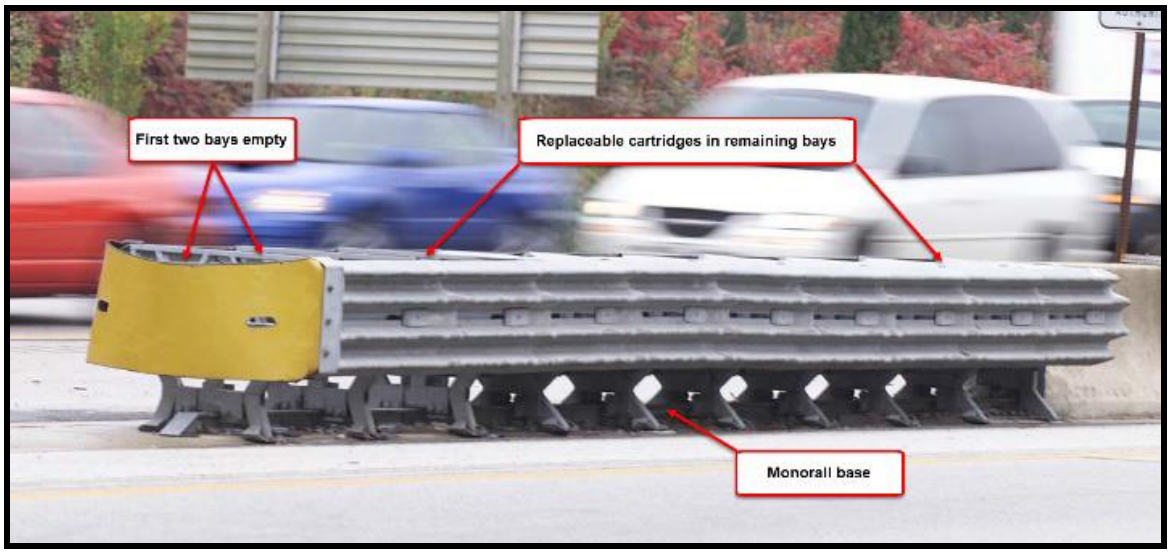
5-SCI7: SCI70GM

End Treatment Type 5-QUAD: QuadGuard

The QuadGuard system can be used for one- or two-way traffic. QuadGuard is non-gating and is intended for use to terminate roadside barrier of various types and other obstructions up to 90" wide. The QuadGuard uses crushable energy absorbing cartridges surrounded by diaphragms. (No longer approved for new installations.)

End Treatment Type 5-QDHS: QuadGuard HS

The Quadguard HS is an end treatment system for design speeds up to 70 mph. The Quadguard HS features space-frame diaphragms that are used in the first three bays of the system, which do not contain a cartridge. If either of these QuadGuard systems is impacted and the cartridges are damaged, they have to be replaced. (No longer approved for new installations.)



End Treatment Type 5-QELI: QuadGuard Elite
(Includes QuadGuard LMC)

The QuadGuard Elite has QuadBeam panels that protect the reusable cylinders. The system is on a monorail base that provides excellent redirective capabilities. The QuadGuard Elite system can safely redirect side impacts up to 20° back toward the impacting vehicles original travel path without allowing gating of the panels. Upon head-on impacts, the Flex Belt nose and QuadBeam panels telescope rearward, absorbing the energy of the impacting vehicle. The QuadGuard Elite system can protect hazards from 24" to 90" wide. (The QuadGuard Elite is no longer approved for new installations.)

QuadGuard Elite

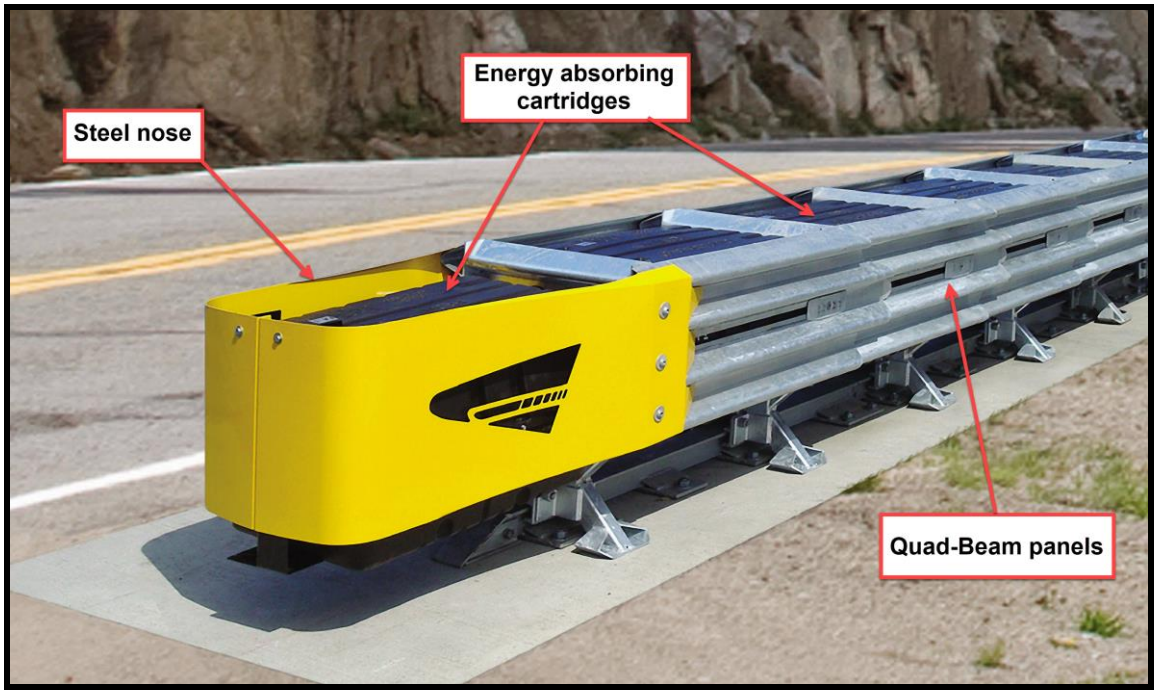
Note: The QuadGuard LMC is no longer manufactured. Existing inventories may still be used on projects.

The QuadGuard LMC (low maintenance crash cushion) can be used for one- and two-way traffic. The QuadGuard LMC is a non-gating system and is used to terminate roadside barrier of various types and other obstructions up to 90" wide. The QuadGuard LMC system uses self-restoring elastomeric cylinders and is recommended for use in potentially high frequency impact areas.

QuadGuard LMC

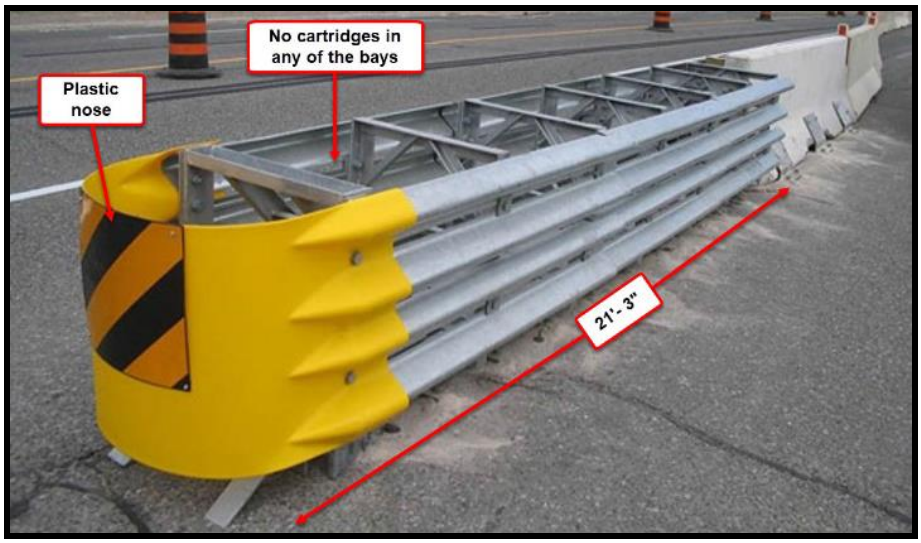
End Treatment Type 5-QM10: QuadGuard M10

The QuadGuard M10 is a redirective non-gating end treatment. This end treatment consists of an engineered steel nose (first bay), tension strut backup, monorail guide stabilizers, anchorage in concrete, and crushable, energy absorbing cartridges surrounded by a framework of steel quad-beam panels (second through seventh bays). It can be used to shield fixed objects of 24 inches wide.

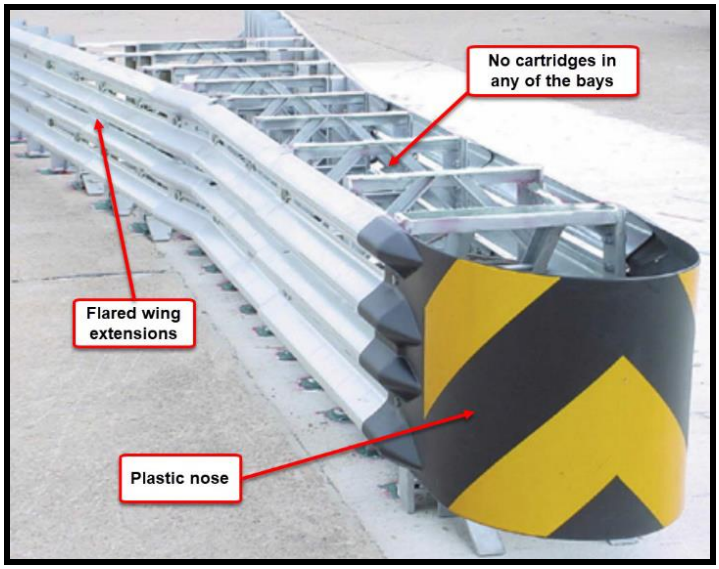


End Treatment Type 5-TRA: TRACC,
End Treatment Type 5-WTRA: WIDETRACC,
End Treatment Type 5-STRA: SHORTRACC,
End Treatment Type 5-FTRA: FASTRACC

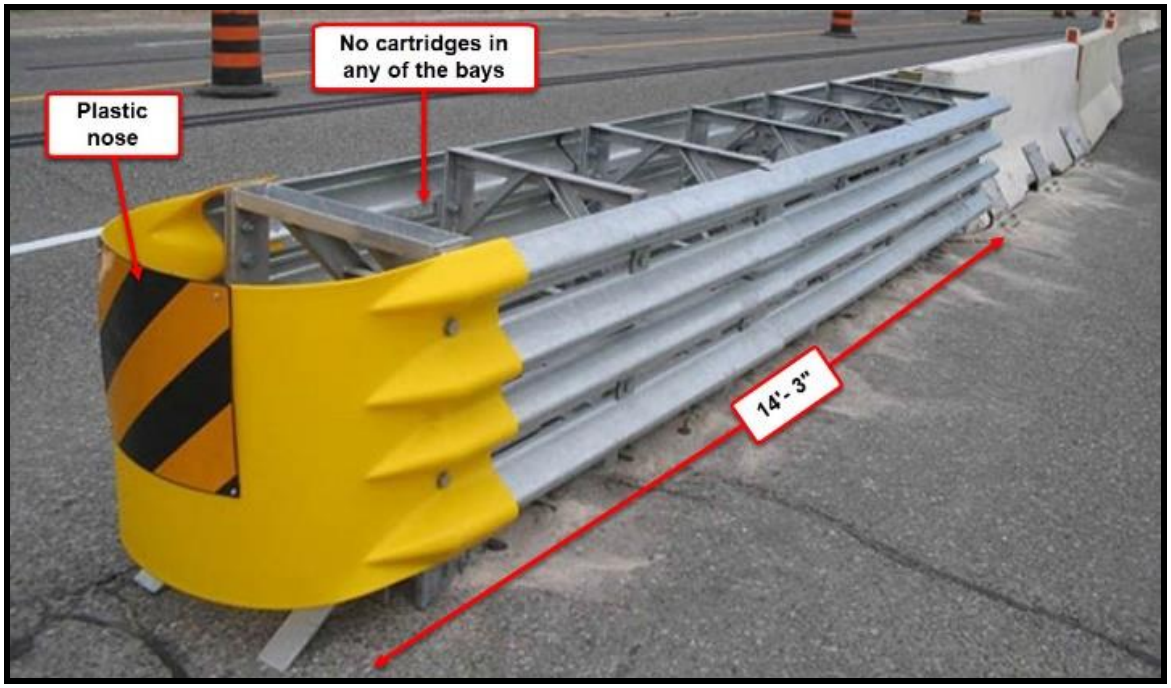
The TRACC (Trinity Attenuating Crash Cushion) family of end treatments can be used in one- and two-way traffic and are re-directive and non-gating. They are intended for use to terminate median barrier. The TRACC systems are installed on new or existing reinforced concrete or asphalt pads. TRACC end treatments do not use crushable cartridges or black boxes. The WIDETRACC is distinguishable from the TRACC by its flared wing extensions. The SHORTRACC is similar to the TRACC but with the second and third stages shortened. The FASTRACC is longer than the standard TRACC because of the addition of a set of standard two-bay side panels on each side of the system. (All TRACC end treatments are no longer approved for new installations.)



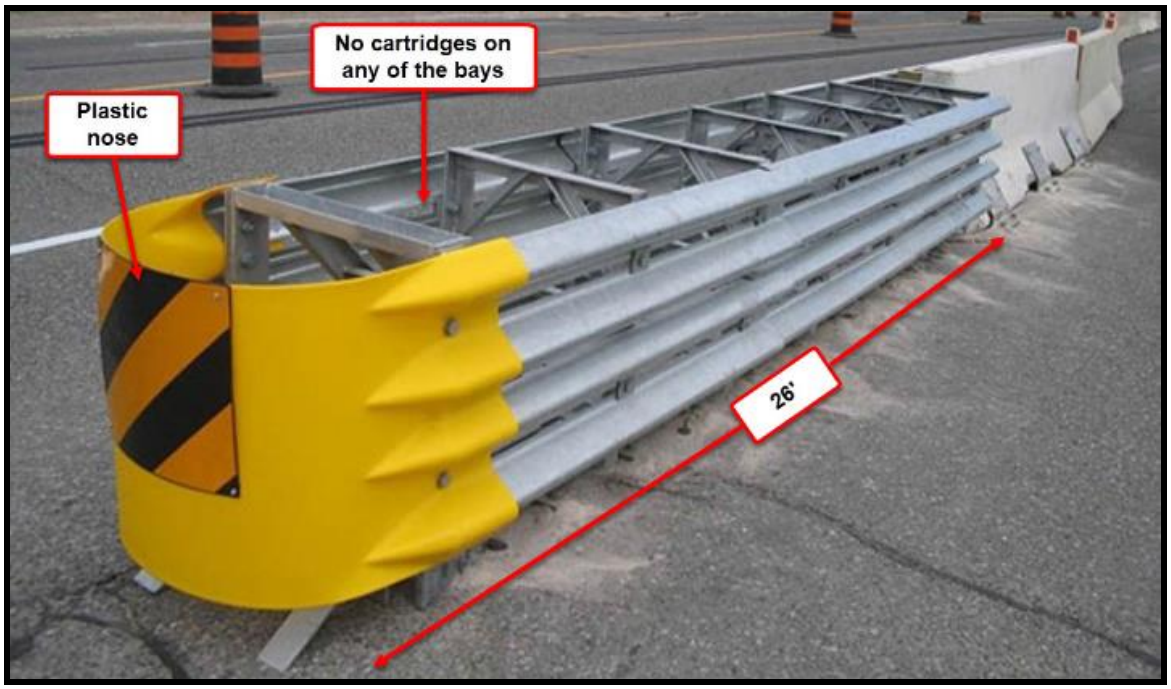
TRACC



WIDETRACC



SHORTRACC

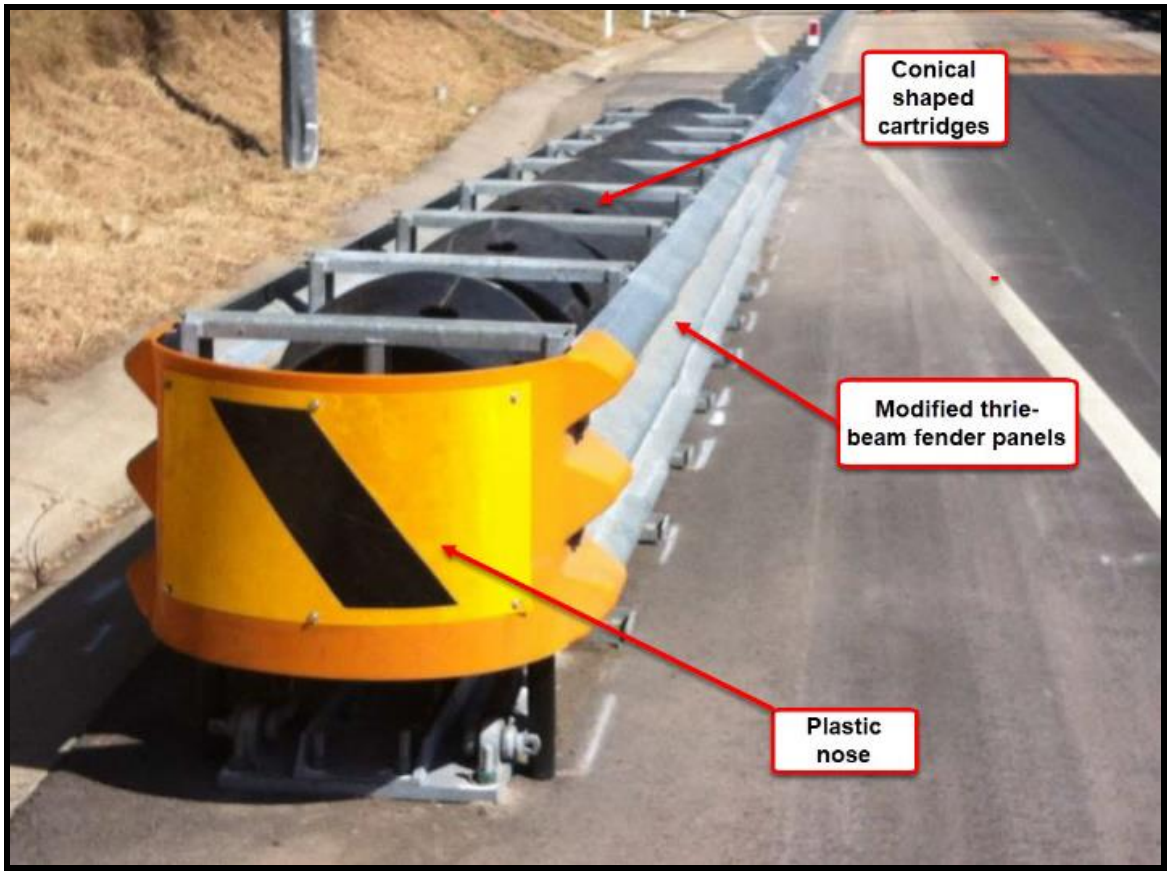


FASTRACC

End Treatment Type 5-TAU: TAU-II

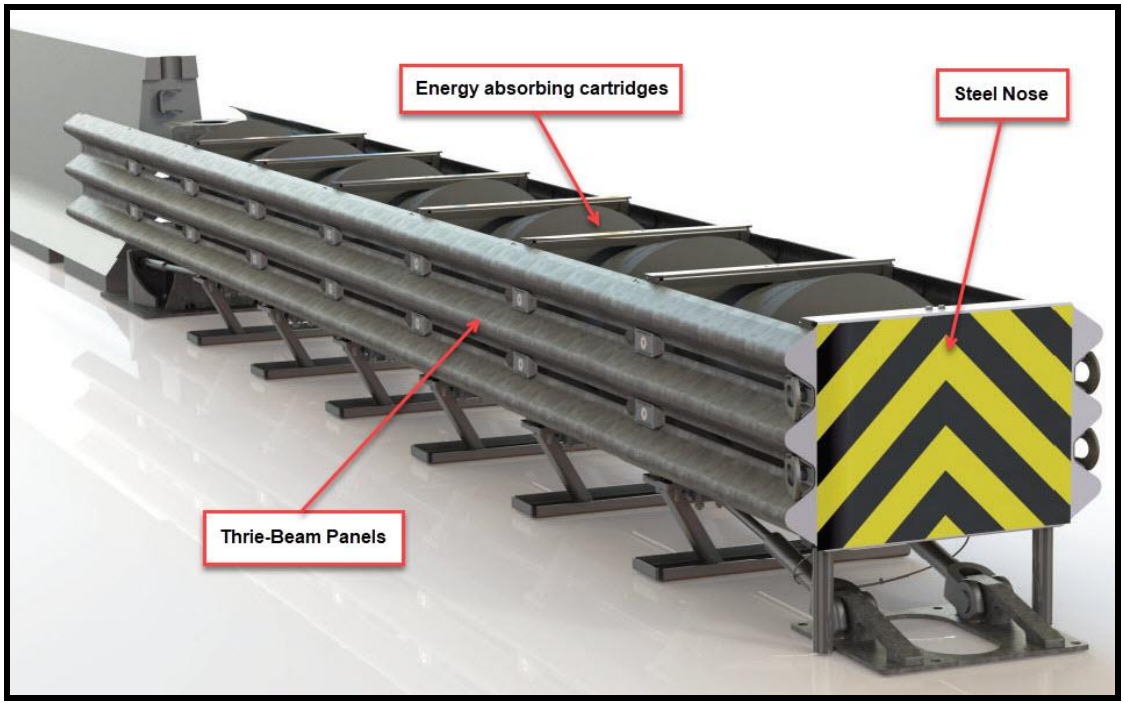
The TAU-II is a re-directive, non-gating crash cushion system for edge of road and narrow median applications. This system is designed for attachment to permanent or portable concrete barrier, and W-beam systems. The TAU-II can be either a four-bay or eight-bay system. Both configurations consist of galvanized steel elements and plastic components made of high molecular weight polyethylene.

(The TAU-II is no longer approved for new installations.)



End Treatment Type 5-TAUM: Universal TAU-M

The Universal TAU-M (TAU-M) is a redirective non-gating end treatment. This end treatment utilizes a cable anchoring system, telescoping thrie-beam panels, and energy absorbing cartridges to absorb kinetic energy and safely contain or redirect impacting vehicles. This end treatment is seven bays in length and is comprised of energy absorbing cartridges, cables, a front cable anchor, a backstop, four end panel mounts, middle support assemblies (mid-supports), cable guides, a front support, a front support leg kit, sliding panels, two end panels, slider kits, slider shims, a tether kit, four tow hooks, and a delineation bracket.



End Treatment Type 5-QST: QUEST

The QUEST is a proprietary system and can be used for unidirectional or bidirectional traffic. The QUEST is a non-gating system and is intended for use to terminate concrete median barrier or W-beam guide rail. When used for bidirectional traffic, FHWA approved transitions are required in the event of a reverse direction impact at the rear of the system.

The main components of the QUEST include a ground-anchored backup assembly, two ground-anchored front anchors, two front rails, two rear rails, nose, trigger assembly, sled, diaphragm, bridge and panel assemblies. All components are galvanized to resist corrosion in accordance with ASTM standards. The series of W-beam panels are supported by the diaphragms with a trigger mechanism at the nose which, when hit, releases a "front assembly" to absorb the energy of impact. The system can be preassembled and moved to the installation site or can be assembled on-site.

(The QUEST is no longer approved for new installations.)

End Treatment Type 5-GRT: G-R-E-A-T

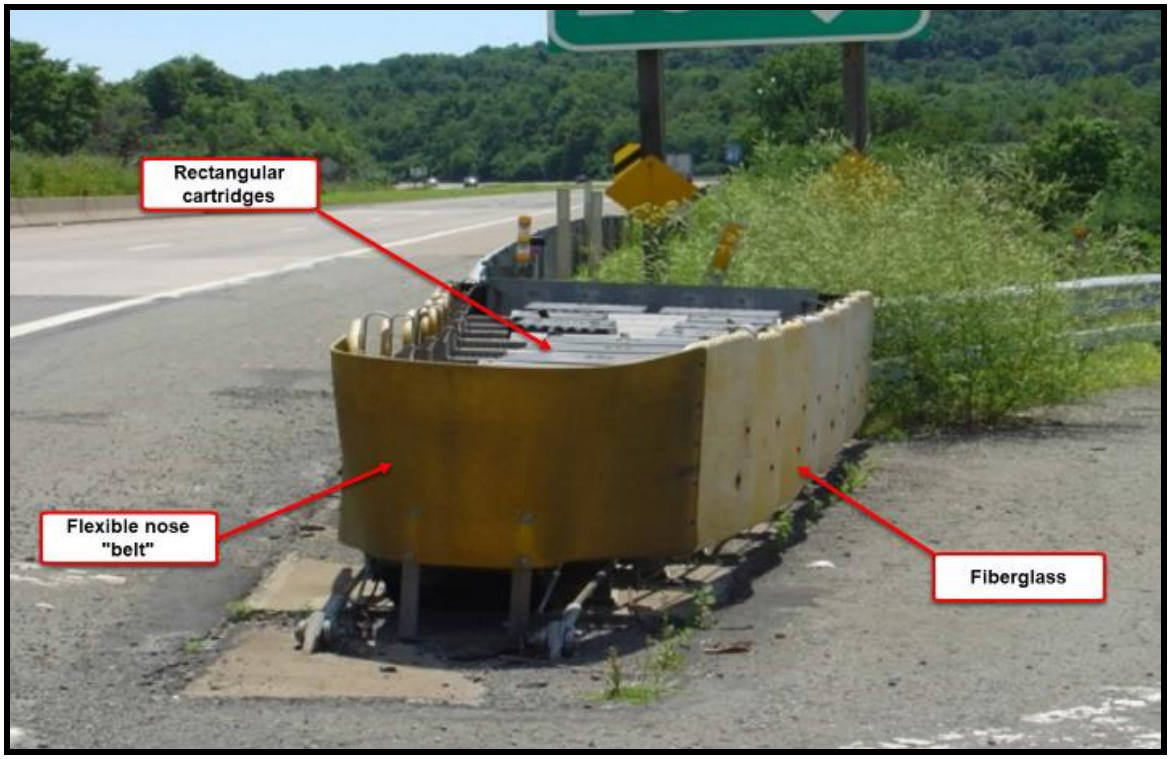
Note: The G-R-E-A-T is no longer approved for installation. Existing installations need inspected.

The G-R-E-A-T (Guardrail Energy Absorbing Terminals) system consists of crushable foam cartridges surrounded by a framework of triple-corrugated steel guide rail. The G-R-E-A-T system can telescope rearward in a head-on impact. The G-R-E-A-T system also has a restraining cable (on 3 bay and longer systems) and chains that will resist lateral movement during side angle impacts. The nose of the G-R-E-A-T system is surrounded with a formed plastic wrap.

End Treatment Type 5-HEX: HEX Foam Sandwich

Note: The Hex-Foam Sandwich is no longer approved for installation. Existing installations need inspected.

The Hex-Foam Sandwich system consists of crushable Hex-Foam cartridges placed between rigid steel diaphragms in a multi-layered “sandwich” construction. A flexible belting material protects the front end of the Hex-Foam Sandwich system. Fender panels protect the sides of the Hex-Foam Sandwich system. The Hex-Foam Sandwich is anchored at the front and rear to stabilize the system during head-on and side angle impacts.

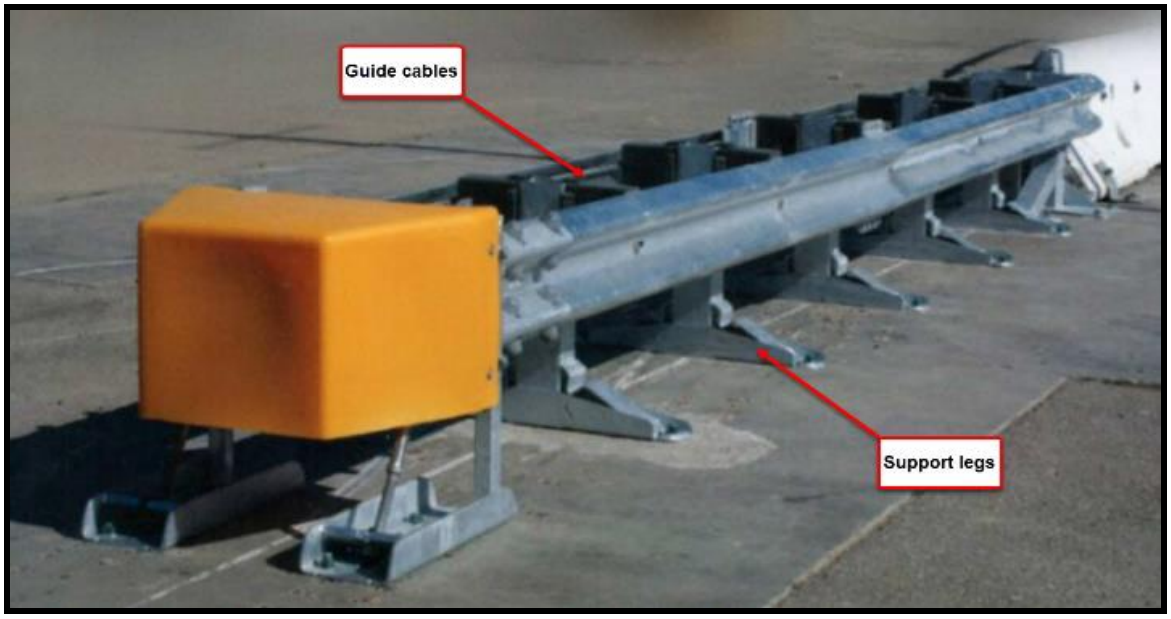


End Treatment Type 5-XTNU: X-TENuator

The X-TENuator is a redirecting, non-gating crash cushion for use with single-faced and double-faced guide rail and concrete barrier. Typical applications are narrow medians or gore areas where guide rail is installed and crossover impacts can occur. It can also be used to shield permanent and temporary concrete ends.

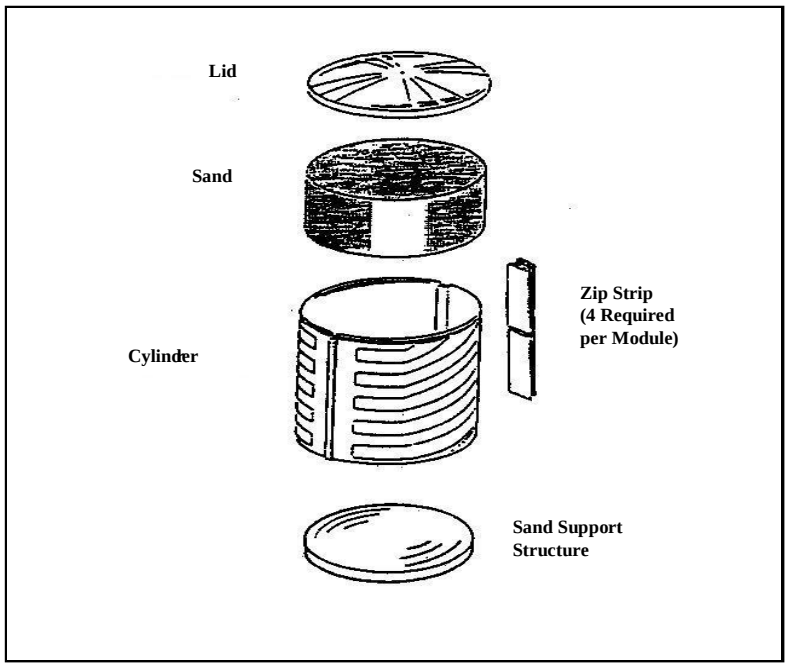
Typical length of the X-TENuator is 24’ 9” with a height of 31”.

(The X-TENuator is no longer approved for new installations.)



End Treatment Type 6-SAND: Sand Filled Plastic Barrels

This end treatment type consists of a cluster of unrestrained plastic barrels partially filled with sand. The energy of an impacting vehicle is dissipated by a transfer of the vehicles momentum to the mass of the Sand Filled Plastic barrels. The Sand Filled Plastic Barrels may be used in different arrangements to shield barrier walls up to 12 feet wide, gore areas and other fixed objects in low frequency impact areas. Sand Filled Plastic Barrels are designed to protect motorists from head-on impacts. Sand Filled Plastic Barrels are <u>not</u> designed to redirect vehicles in side angle impacts.



MISCELLANEOUS END TREATMENTS

These are end treatment systems that do not fit in a category previously discussed. Some of these systems are no longer installed; some have not yet been installed.

End Treatment Type M-TDWN: Turned Down Concrete End Anchor

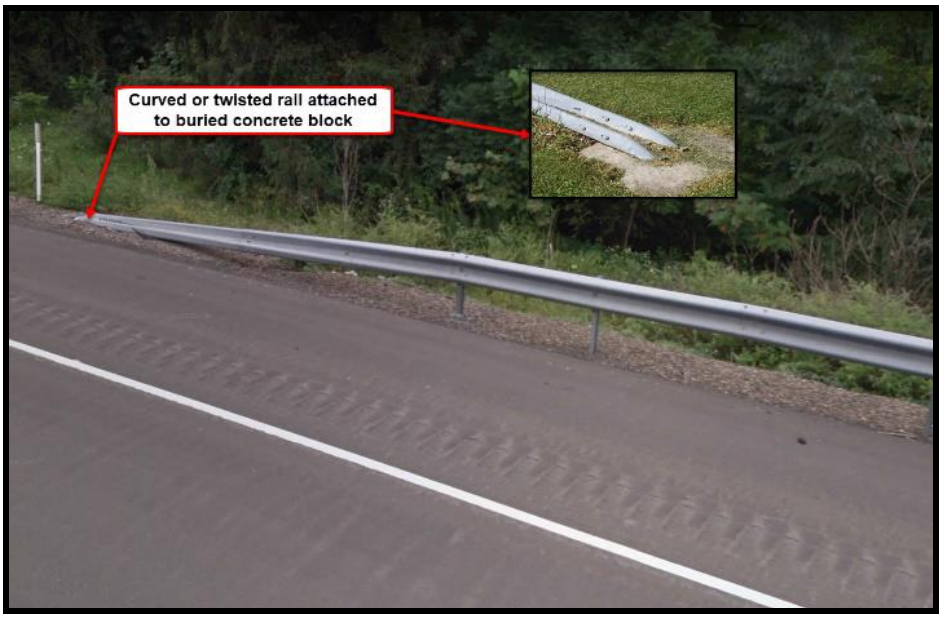
The Turned Down Concrete End Anchor is a curved or twisted rail element with one end attached to the end of a w-beam system and the other end attached to a buried concrete block.

This end treatment is considered Undamaged when used on the trailing end of guide rail installed on all divided highways. It is also considered Undamaged when:

- On non-NHS (National Highway System) routes with a posted speed limit less than 45 mph or a traffic volume less than 4000 ADT when:
  - Located at the leading end of guide rail installed on divided non-NHS routes
  - Located on both the leading and trailing ends of guide rail installed on undivided non-NHS routes

Conversely, this end treatment is considered Damaged when used on the leading end of guide rail installed on all divided NHS routes. The Turned Down is also considered Damaged when:

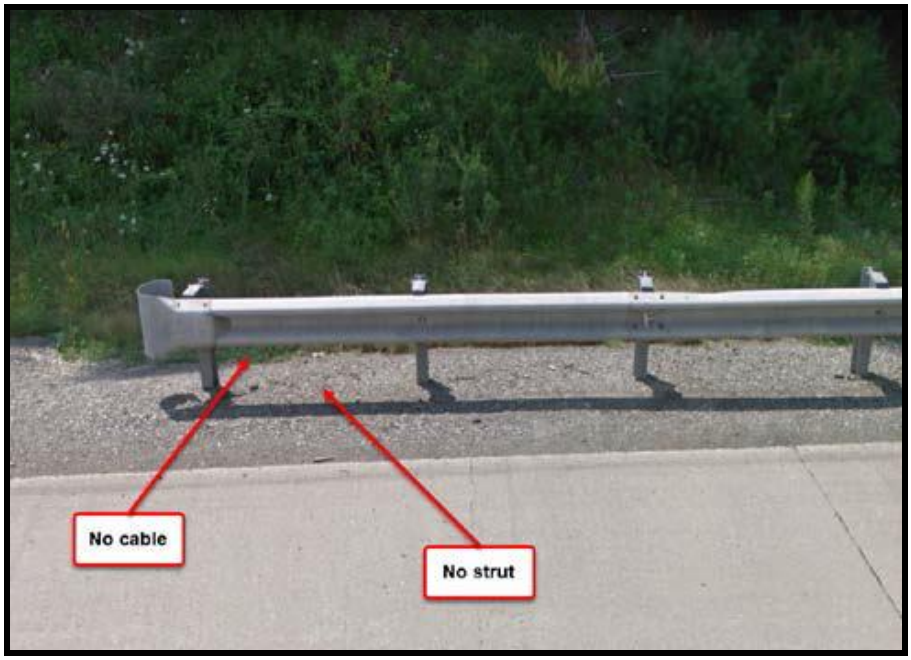
- Located on undivided NHS routes, both leading and trailing ends of the guide rail
- On non-NHS routes with a posted speed limit of 45 mph and above AND with a traffic volume of 4000 ADT or higher when:
  - Located at the leading end of guide rail installed on divided non-NHS routes
  - Located on both leading and trailing ends of guide rail installed on undivided non-NHS routes



End Treatment Type M-Bend: Blunt End

The Blunt End System, also called Fist, Boxing Glove, or Terminal Section Single, is a curved or circular fist-shaped metal device that is attached to the end of a strong-post w-beam.

The Blunt End is considered Undamaged only when used at driveway and field openings if it is turned away from the roadway to prevent spearing into an errant vehicle. It should not be used to terminate guide rail that is turned onto an intersecting roadway and is considered Damaged in that situation.



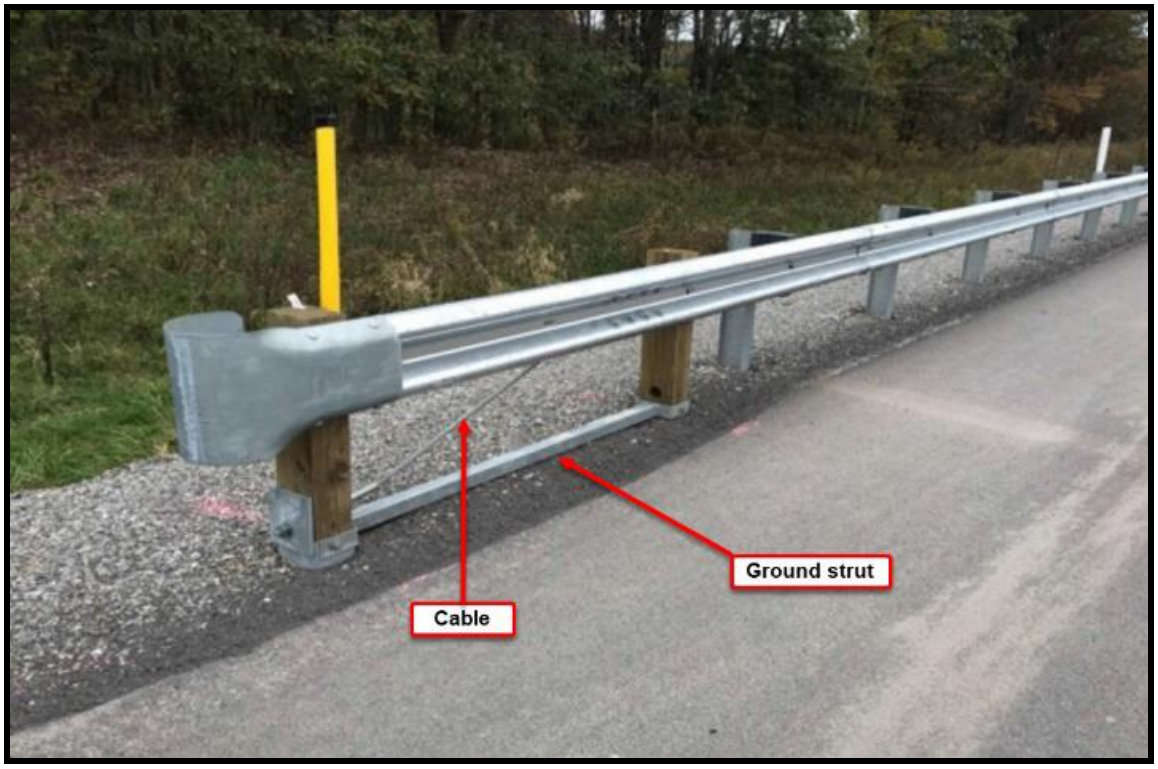
At driveway or field entrance

End Treatment Type M-2SA: 2-S Post Anchorage

The 2-S post anchorage is used on the trailing end of a string of guide rail, typically on high-speed divided highways. Its purpose is to anchor the free end of the guide rail string. The post anchorage is not crashworthy so it is considered undamaged only on the trailing end of guide rail installed on divided highways where opposing traffic cannot hit it head on.

End Treatment Type M-SPAT: Type 31 Strong Post Anchor Terminal

The Type 31 Strong Post Anchor Terminal is used on the trailing end of a string of Type 31 Strong Post Guide Rail (31" rail height), typically on high-speed divided highways. Its purpose is to anchor the free end of the guide rail string. The anchor terminal is not crashworthy so it is considered undamaged only on the trailing end of guide rail installed on divided highway where opposing traffic cannot hit it head on. **The primary difference between the Type 31 Strong Post Anchor Terminal and the 2-S Post Anchorage is a ground strut that connects the two terminal posts.**



End Treatment Type M-SCON: Sloped Concrete

The Sloped Concrete system is the last section of a concrete barrier system. The sloped concrete section transitions from ground level to full barrier height. The sloped concrete section is used when an impact attenuator is not required. The slope is typically 7' long.

Not Typical Length But Acceptable

End Treatment Type M-ARMG: ArmorGuard

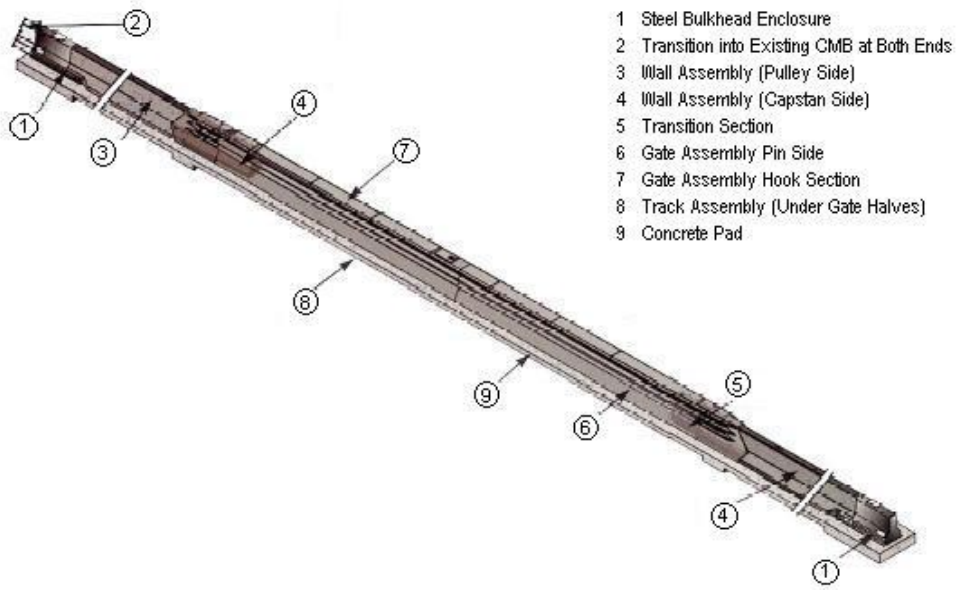
The ArmorGuard Gate is a proprietary longitudinal non-gating barrier specifically designed to span a permanent opening in a concrete median barrier ranging from 26 ft to 52 ft long. The ArmorGuard Gate is a heavily reinforced steel barrier that is designed for emergency openings. The typical length of each gate section is 13 ft and the effective overall height is 33 in. The ArmorGuard Gate is 28 in wide at its base.

Hinge assemblies at the ends of each unit and compressed air-activated, retractable wheels on each unit allow the ArmorGuard Gate to be disconnected from the rigid barrier after removal of the aluminum cover plate and the steel connecting pin. The ArmorGuard Gate can then be swung open from one end or completely removed to allow passage of vehicles. One or two persons can accomplish this process in 5 minutes or less.

End Treatment Type M-BGAT: Barrier Gate

The Barrier Gate is a longitudinal non-gating barrier system that opens to provide an opening for controlled access through barrier. The outermost ends of the gate are equipped with transition assemblies that attach to custom concrete median barrier sections. The movement of the gate is directed by track assemblies anchored to a concrete foundation and guide rail assemblies anchored to the tops of the concrete transition assemblies.

This system is approved for use in Pennsylvania. None have been installed to date.



End Treatment Type M-VULC: Vulcan Gate

The Vulcan Gate is a proprietary longitudinal non-gating barrier system specifically designed to provide an emergency opening in a concrete median barrier. The median openings range from 27 feet for a two-section Vulcan Gate (V2000) to 81 feet for a six-section Vulcan Gate (V6000).

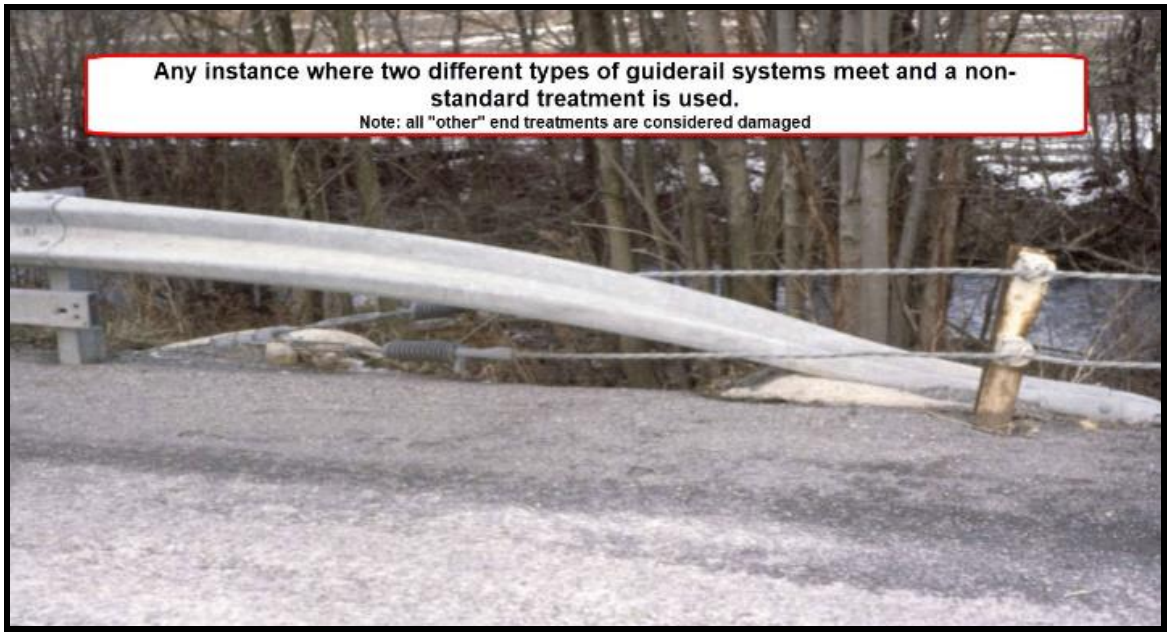
A typical Vulcan Gate system is comprised of existing Vulcan segments, two transitions to concrete median barrier and two hinge segments. The hinges may also be used in a run of Vulcan barrier to create a gate opening.

End Treatment Type M-BCON: Bridge Connection

A Bridge Connection end treatment is required any time a barrier system terminates at a bridge parapet or pier. The Bridge Connection, along with thrie-beam rail (System Type U), serves as a transition from the barrier to the structure. The barrier does not have to be attached to the structure to be classified as a bridge connection. If the barrier is properly connected to the structure, it is considered an Undamaged Bridge Connection. The Bridge Connection is considered Damaged if there is no connection or if the barrier is not properly connected to the structure.

End Treatment Type M-OTH: Other

This end treatment type is to be used for any terminus of a barrier system not described in the previous end treatment types **or where there is no end treatment beyond the last post or rail element.** This includes those instances where two different types of guide rail meet and a non-standard treatment is used. All end treatment types M-OTH are considered damaged.

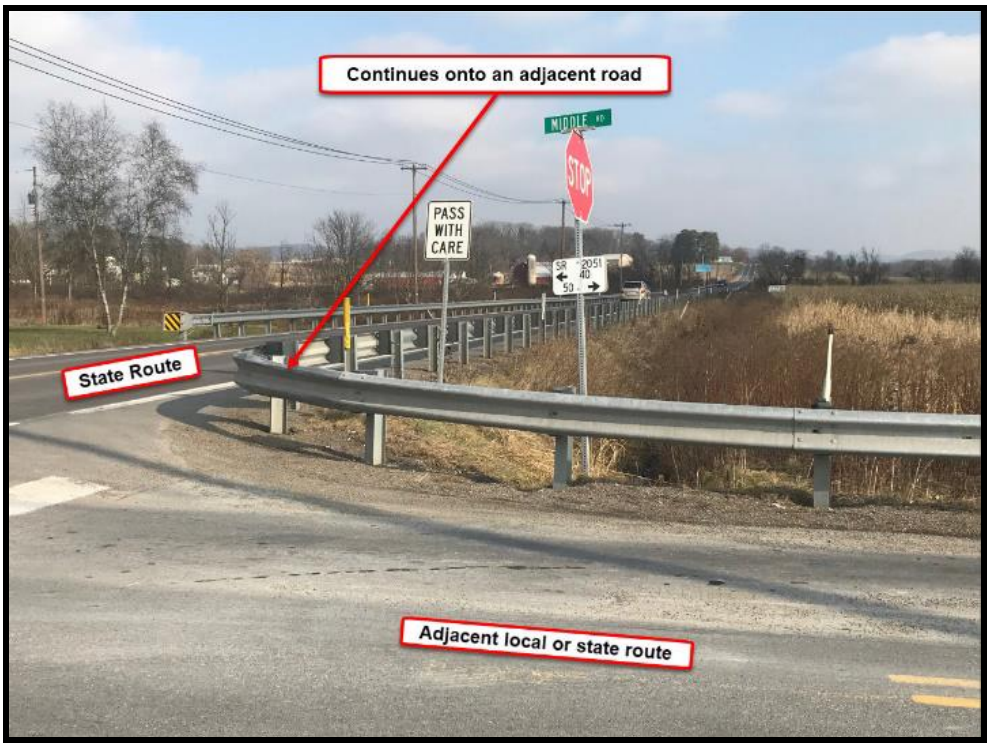


Cable System transition to W-Beam System

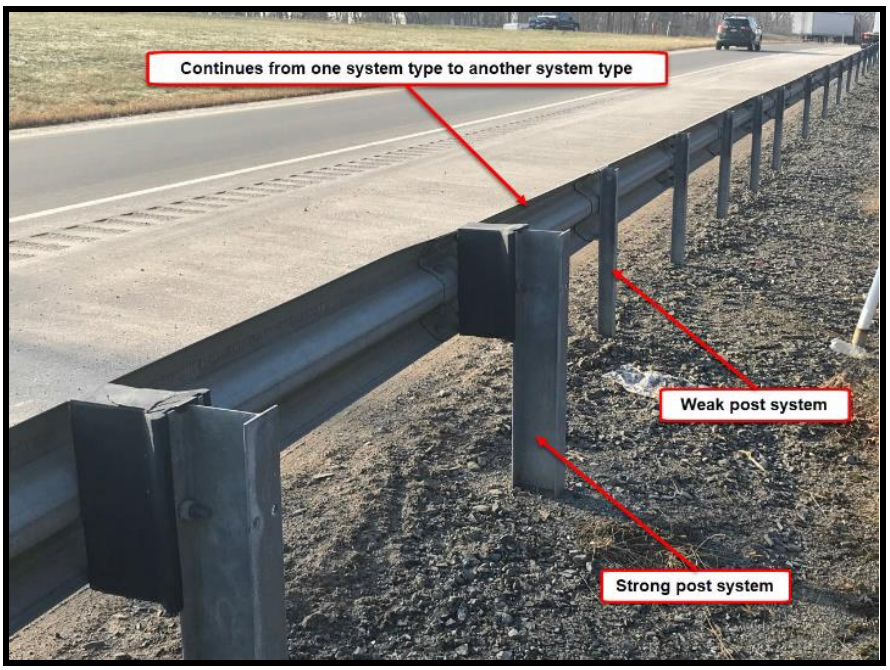
Sloped Concrete on a W-Beam System

End Treatment Type M-CON: Continue

This end treatment type is used to indicate the continuation of the barrier or guide rail system onto an adjacent STAMPP segment, intersecting road, ramp or structure. This end treatment type is also used to indicate the transition from one type barrier to another, such as strong post w-beam to weak post w-beam.



Continue from SR to SR



Continue Weak Post to Strong Post W-Beam

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PHOTO GUIDE

GUIDE RAIL/MEDIAN BARRIER
CONDITION IDENTIFICATION GUIDE

Post Deflection

Description:

Guide Rail posts are intended to stand vertically. This condition is characterized by posts that are no longer vertical.

Possible Causes:

Posts can be moved to a non-vertical position by vehicular impact, deterioration, or loss of support through erosion.

Severity:

None: All posts are standing vertical; no deflection in any posts.

Low: The posts are standing at an angle <15° from the vertical.

Medium: The posts are standing at an angle ≥15° and ≤30° from the vertical.

High: The posts are standing at an angle >30° from the vertical.

Extent:

Record the percentage of posts deflected within a guide rail or barrier system for each severity level. See the survey block below.

POST DEFLECTION			NONE	<10%	10-40%	>40%	#POSTS
				7	8	9	>30°
				4	5	6	15° - 30°
			0	1	2	3	<15°

(Actual form layout will vary)

Post Deflection
Low Severity

Post Deflection
Medium Severity

Post Deflection
High Severity

Cable Sag

Description:

The cables in a system are intended to be taut, i.e., stretched between two posts with little or no sag. This condition indicates the degree to which the cables have loosened or sagged from their original location. This condition is inventoried only for cable guide rail systems.

Possible Causes:

Cable can sag from its original position because of loss of the support at the end anchor, removal or loss of support hardware, or stretch due to age and temperature expansion.

Severity:

None: All cables are horizontal; little or no sag.

Low: The cables have sagged, <6 inches.

Medium: The cables have sagged ≥6 inches and ≤12 inches.

High: The cables have either sagged >12 inches OR have become detached from the support posts.

Extent:

Record as the percentage of the cable system length with cable sag for each severity level. See the survey block below.

CABLE SAG			NONE	<10%	10-40%	>40%	LENGTH
				7	8	9	>12"
				4	5	6	6" - 12"
			0	1	2	3	<6"

(Actual form layout will vary)

Cable Sag ≥6” & ≤12”: Medium Severity

Cable Sag in top cable >12”, bottom cable none: High Severity

Deterioration

Description:

This condition is characterized by barrier elements that are rotted, rusted, cracked or otherwise damaged.

Possible Causes:

This condition can be caused by lack of maintenance, vehicular accident damage, aging materials, weather conditions, defective materials or anything that causes damage to the elements of the guide rail or barrier system.

Severity:

None: No deterioration; barrier elements like new.

Low: Surface rust or dents are apparent on any of the steel elements. Concrete barriers have spalled areas.

Medium: Structural rust with loss of section is apparent on steel elements. Wood posts are cracked. Concrete barriers are cracked.

High: Steel elements are rusted through. Wood posts are rotted. Portions are broken out of concrete barrier.

Extent:

Record as a percentage of the guide rail or barrier system length that is affected by the deterioration for each severity level. See the survey block below.

DETERIORATION			NONE	<10%	10-40%	>40%	LENGTH
				7	8	9	ROTTED/RUSTED THRU/BROKEN
				4	5	6	STRUCTURAL RUST/CRACKED
			0	1	2	3	SURF.RUST/SPALLED/DENTED

(Actual form layout will vary)

Low Severity
Dent w/Surface Rust

Low Severity
Surface Rust on Posts

Medium Severity
Cracking w/ Spalls

Medium Severity Structural Rust

High Severity Hole in Steel Element

High Severity Portion Broken Out

Hardware

Description:

For a guide rail to operate effectively, all support and fastening nuts and bolts, posts, cables, panels and other necessary items must be in place. This condition is characterized by missing or defective hardware.

Possible Causes:

Affected hardware can be corroded by age and weather, damaged by vehicular impact, stolen or removed for use in another location.

Extent:

Record as the percentage of the guide rail or barrier system length that is affected by the missing or defective hardware. See the survey block below.

HARDWARE	NONE	<10%	10-40%	>40%	LENGTH
	0	1	2	3	LOOSE/MISSING/DEFECTIVE

(Actual form layout will vary)

Missing W-Beam Panel/Posts & Bridge Connection

W-Beam Panel Disconnected From Post

End Treatment Disconnected from Post

Height

Description:

This condition identifies when the guide rail or barrier system is not at the appropriate height.

Possible Causes:

Placement of successive pavement overlays that, by virtue of their depth, reduce the effective roadside and median guide rail or barrier height cause deficient height.

Extent:

Record as the percentage of the guide rail or barrier system length that is deficient in height. See the survey block below.

The height is measured from the ground level in front of the barrier to the lowest point of the top cable, top of the W-beam, or top of the concrete barrier.

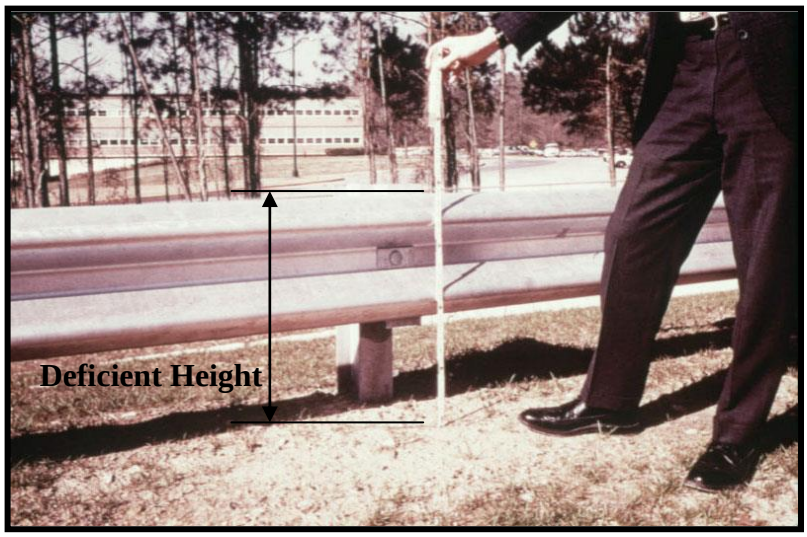
- On strong post W-beam systems, the height is acceptable if the height to the top of the rail is a minimum of 26.5” from ground level.
- On concrete barrier systems, the height is acceptable if any of the 3” vertical face of the base is visible.
- On Type A and B cable systems, the cable height is acceptable if the cable is horizontal and at 30” from ground level.
- For Type L, M, N, P and Q cable barrier systems, refer to the write-ups for each system for typical installation heights.

HEIGHT	NONE	<10%	10-40%	>40%	LENGTH
	0	1	2	3	DEFICIENT HEIGHT

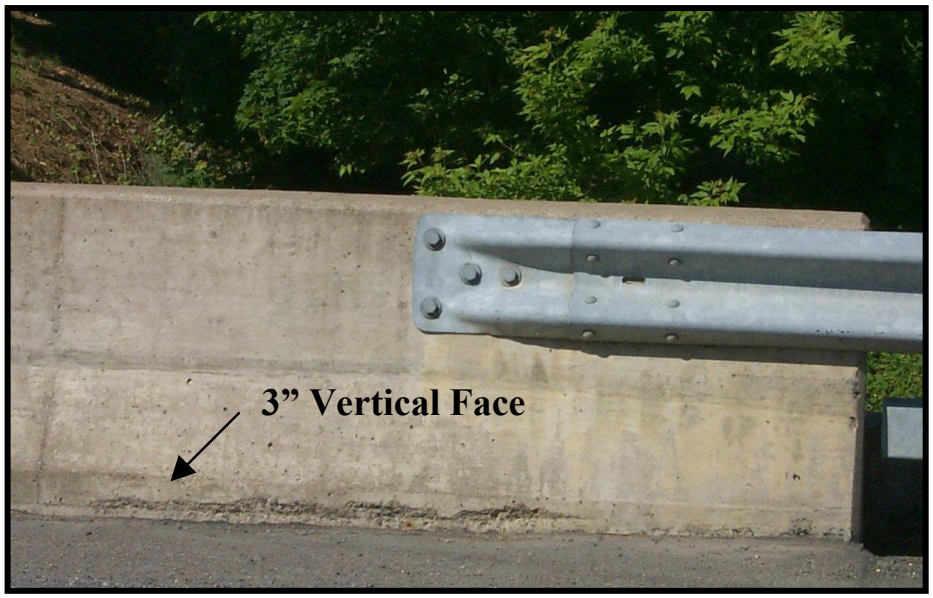
(For all barrier types excluding W-beam systems. Actual form layout will vary.)

HEIGHT	NONE	<10%	10-40%	>40%	LENGTH
		4	5	6	HEIGHT 26.5" to 30.5"
	0	1	2	3	HEIGHT < 26.5""

(Second height option for W-beam systems. Actual form layout will vary.)



Deficient Height Example – Less Than 26.5” to Top of W-Beam Rail



Concrete Barrier Height is Sufficient

Candidate For Removal

A guide rail section may be considered a Candidate for Removal if there are no fixed objects behind it and the slope behind the guide rail is relatively flat. The criteria used to determine guide rail necessity is:

CRITERIA – CANDIDATE FOR REMOVAL

1. If the ADT is greater than or equal to 2000 and fill or embankment height is less than 10 feet and there are no fixed objects on the slope.
2. If the ADT is less than 2000 and fill height is less than 20 feet and there are no fixed objects on the slope.

   Fixed Object = 6 inches in width or length (i.e. rock, tree, utility pole, etc.)

Check the box for Candidate for Removal on the right side of the survey sheet if the location of the guide rail system meets the criteria for removal. Checking the Candidate for Removal box does not mean the guide rail will be removed. This box is a flag notifying the appropriate personnel at the County level that the section of guide rail should be evaluated for necessity.

Side Dozing Required

Side dozing is required to remove any build-up of debris or vegetation accumulated under the guide rail. This accumulation will prevent proper drainage of the shoulder area and needs to be removed. Check the box for Side Dozing Required on the right side of the survey sheet if there is debris or vegetation under the guide rail system.

ET-Plus End Treatment Inspection Checklist

COUNTY: _____ **SEG:** _____ **INSPECTED BY:**

SR: _____ **OFFSET:** _____ _____

SIDE: _____ **DATE:** _____

ITEM	Yes	No	Comment
Top of rail is between 26 ½ inches and 27 ¾" above shoulder or finish grade.	☐	☐	
Soil tubes should not protrude above the ground more than 4".	☐	☐	
If present, the bolts at the top of the foundation tubes are not over-tightened, deforming the walls of the tube.	☐	☐	
Impact heads are parallel to top of rail and are not tilted sideways.	☐	☐	
The impact head does not encroach on the shoulder.	☐	☐	
Impact head has not moved to where the rail element is not butted up to the beginning of the bending slot or cutting blades.	☐	☐	
If present, 8"x8" bearing plate at post 1 is positioned with the 5" dimension up and the 3" dimension down and has been secured to prevent rotation with a bent galvanized nail.	☐	☐	
Any cables are taut. Generally deflection should be one inch or less when hand pressure is applied.	☐	☐	
Cables are not twisted.	☐	☐	
All bolts are snug.	☐	☐	
Wood breakaway posts have two 3 ½" breakaway holes located parallel to the roadway with the center of the top hole located at the ground line.	☐	☐	
If present, the cable anchor brackets are properly attached to the W-beam guardrail.	☐	☐	
Composite or wood offset blocks are not rotated and have been secured to prevent rotation.	☐	☐	